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Foundry Textbooks

The subject of textbooks has come up for consideration by two committees upon which we serve. The solution of the problem of what foundry textbooks to recommend to a student is not easy, as any selection made must of necessity cover some established syllabus. This is not all, however, for the student of foundry practice would not do justice to himself or the industry he hopes to join, if he merely acquired the knowledge requisite to satisfy his examiner. There is, for example, a good textbook, specially compiled for candidates taking the City and Guilds of London examinations in foundry practice. A second, compiled by the chief instructor at the Foundry Craft Training Centre at West Bromwich, is excellent for use by apprentices.

It is usual to list two types of textbooks for students—the essential ones and those suitable for reference. The choice of the former is almost automatic, but for the latter there appears to be a long list. Such a catalogue is, however, often more of a "will o' the wisp" than a reality, for many of the standard works are not only out of print but out of date. There is a pressing need for study of foundry practice to include the already-established newer processes, yet without any extension of student hours. Sometime in the near future, a decision will have to be made as to whether to replace a subject like loam moulding by, say, shell moulding. After all, more firms practice the latter than the former. Such a change would require a new textbook, and fortunately one is available.

The availability of reliable textbooks for entrants to and students within the industry is a matter of prime importance. It is worth noting that the French foundry interests have made themselves responsible for provision of such books at a price which the boys can afford to pay. The Americans, too, are well provided with foundry textbooks, but, like this country, they are not logically co-ordinated and there is much overlapping. Whilst it is too much to hope that in the foreseeable future any rational effort will be made to ensure the provision of a set of textbooks for the foundry student and other grades of foundrymen, yet when such a problem is tackled, those responsible should appoint one man and one man only to ensure complete coverage without overlapping, at least for each grade of textbook. Even books on patternmaking, which used not to "date" so quickly, now need drastic revision to include metal patterns, pressure-cast plaster, and quite a few other new angles. Obviously, the basic principles have long been established, but the newer applications need amplification. The situation is not too bad, but it is not static. However, unless an extra year of study be added, the number of student-hours being fixed, drastic revision of syllabuses must be envisaged, whilst still retaining balance.

G

Congress Paper Author

Mr. John Steele, the 1954-55 president of the South African branch of the Institute of British Foundrymen, is the author of the official Exchange Paper, "A Jobbing Investment Foundry in South Africa," printed on page 561 of this issue. Born in 1923 at Wishaw, Scotland, he was educated at Wishaw High School and received his technical education at Stow College of Engineering, Glasgow. For the latter course he was awarded the McInnes-Shaw Prize. In 1944 he was awarded the Surtees Silver Medal by the Scottish Branch of the Institute and two years later obtained his Intermediate Certificate in the City and Guilds examinations. Mr. Steele served his apprenticeship as a moulder with the Clyde Alloy Steel Company, following which he was employed in the iron and non-ferrous foundries of G. & J. Weir, Limited. In 1947 he emigrated to South Africa and after a period of service as a moulder, he entered the laboratory of the South African Iron and Steel Corporation. In 1949 he became foundry manager of the precision casting department of Rely Products, Limited, Johannesburg. Mr. Steele at the time of writing the Paper referred to held an appointment with Precision Dental Laboratories (Pty.), Limited, Johannesburg, as manager of this company's new foundry, placing on a production basis the lost-wax process of industrial investment casting as developed in the dental laboratory of the firm.

Monel Metal Anniversary

Last Friday, Henry Wiggin & Company, Limited, were the hosts to the technical Press at a cocktail party held at the Savoy Hotel, London. The function was to celebrate the launching of monel metal 50 years ago. It was really the discovery of Mr. D. H. Browne and Mr. R. C. Stanley, then the metallurgist and assistant general manager of the International Nickel Company. The first large order was for 120 tons to be used for the roof of the New Pennsylvania Railroad Company in New York City. Since then about 400,000 tons has gone into industrial applications. It is not a foundry alloy, but scrap monel is often used in the making of Ni-Resist cast iron. The company was addressed by Mr. I. A. Bailey, managing director of Henry Wiggin & Company, Limited, who very interestingly described the development and growth of monel since its initial discovery.

Latest Foundry Statistics

According to the British Iron and Steel Federation, the number at work in the steel foundries on September 10 was, at 19,915, 282 greater than a month earlier but much the same as in July. The average weekly output of steel castings in August was 5,300 tons. This is some 600 tons per week more than in July and 300 tons per week more than in August, 1954. About 1,200 of this output was alloyed.

As reported by the British Bureau of Non-Ferrous Metal Statistics, the output of copper-base castings during September was 5,144 tons. The production for the first nine months of this year was 45,604 tons, which is 208 tons less than for the same period in 1954.

Group Apprentice Training

A new form of apprentice training, by which firms too small to run their own comprehensive schemes may pool resources and train each other's young workers, is contemplated by the Midlands Region of the Engineering Industries Association which has a membership of 900 firms. First particulars of the proposal were given by the chairman, Mr. Arthur Keats, at a dinner of the Association in Birmingham on November 9. Mr. Keats said that an experiment on similar lines inaugurated by the West London group of the Association had proved a success and had prompted the idea in the Midlands. There was no scarcity of the right type of boys who wished to be trained but everyone in the engineering trade was aware of a serious shortage of personnel to replace the present skilled craftsmen. This shortage was partly caused by the lack of apprentice-training facilities among the medium and smaller firms. Such training was a full-time job and at present only large firms were able to run schemes on the necessary scale.

The new proposal was that each firm should employ its own apprentices for the first and final parts of the course so that the young people's sense of loyalty to their own firm might be developed. After the initial period, the apprentices would be exchanged amongst the co-operating firms, thus enabling their experience to be considerably widened. Arrangements would also be made for them to pursue theoretical studies at the colleges of technology in the normal way. A meeting to work out the plan in more detail is to be held in the New Year. It will be remembered that the iron-founding industry has for several years adopted a group training scheme for its craft apprentices of somewhat similar nature to that now proposed for the Midlands Engineering Industries Association.

Film Review

Lloyds at Derby, a sound film having a showing time of of about three-quarters of an hour, produced by the Big Six Film Unit for F. H. Lloyd and Company, Limited, James Bridge Steelworks, Wednesbury.

This film covers the modernization of the Parker Steel Foundry Company, Limited, of Derby, a wholly-owned subsidiary of the Lloyd group. For many years, it has been quite usual for the management to take "progress" photographs of new buildings and their equipment. This film, the commentator for which is Mr. Lionel Marson, very interestingly takes this type of recording a step further, by emphasizing how by careful planning, snags can be avoided and the work proceeded with more quickly. The suppliers of the various pieces of equipment chosen receive the acknowledgments they deserve—but rarely get. Everything is related—as this is a publicity film and not a documentary picture—to the quality of the firm's productions. Special interest is provided for founders having major rebuilding and modernization schemes in mind.

London IBF "Ladies' Night"

Members of the London branch of the Institute of British Foundrymen who wish to attend the annual dinner/dance and cabaret on November 25, and have not yet applied for tickets, should do so immediately. The function will take place at 6.30 for 7 p.m. at the Piccadilly Hotel, London, W.1. Members are invited to bring guests: all applications for tickets (30s. each) should be addressed to the honorary social secretary, Mr. W. R. Buxton, Eyre Smelting Company, Limited, Tandem Works, Merton Abbey, London, S.W.19.

A Jobbing Investment Foundry in South Africa*

By J. Steele

This Paper outlines the establishment of the first industrial investment-casting foundry in South Africa. The period covered is five years, from the initial experimental stage to present-day full production capacity. The early history of the foundry is briefly outlined in the introduction and then the subject matter of the Paper is divided into three sections:—The first section is entitled "process and personnel" a title which is self-explanatory and reviews the investment-process used and personnel employed. To overcome belated overseas delivery periods and economic considerations, certain equipment was constructed and a special procedure adopted. This is dealt with in detail under "procedure" in the second section, and includes:—(1) *The design and construction of an electric melting furnace as used in conjunction with a welding transformer;* (2) *the production of alloy steel by crucible melting;* (3) *a paraffin-fired muffle for mould baking and the heat-treatment of castings; and* (4) *the establishment of mild-steel castings production by "Thermit." Of particular interest in this section is the application of exothermic feeding sleeves for investment moulds. The third section deals with a selection of the castings produced.*

Introduction

The mass-production of small precision parts is the normal function of investment moulding. Although the lost-wax process was not at first envisaged, nevertheless, the principle underlying the establishment of an investment foundry in South Africa was the repetitive production of small castings. The fact that an associate company would produce ethyl-silicate locally was an added inducement to proceed on this venture. The investment-moulding method adopted was the "Shaw"[1] process.

Premises were obtained which had previously been used as a non-ferrous foundry, and the floor area of 5,000 sq. ft. was considered adequate. Included in this purchase were two forced-draught pit-furnaces and sundry items of fettling equipment.

The first 18 months were occupied with experimenting in the process, using indigenous materials. Simultaneously, a market survey was conducted to determine the type of work which might be expected, and the necessary equipment. This survey indicated that the probable trend would be towards the production of castings on jobbing lines; the particular application being in the field of castings which would alleviate the shortage of skilled men and machines in the engineering industry. Another demand envisaged was that of replacement of machine parts, normally ordered from overseas. The past four years have proved this assumption to be correct. The subject matter which follows will outline the methods adopted to deal with the many interesting problems subsequently involved.

* Exchange Paper from the South African branch of the Institute of British Foundrymen presented at the fifty-second annual meeting and International Foundry Congress in London last June. The Author was then foundry manager, P.D.L. Precision Castings (Pty.), Limited, Johannesburg, South Africa.

SECTION I

The "Shaw" process of moulding has been fully described in an article published in *Machinery*[2], but for the sake of providing a complete understanding of the background to this Paper, it is intended briefly to outline this process.

The Process

Moulding

The pattern to be reproduced is placed on a baseplate with runners and risers in position. A good-quality wax paper is wrapped around the form and held in position with strong elastic bands. This replaces the moulding box used in foundry practice. The pattern, baseplate and paper are coated with a suitable parting-medium of such a nature that neither detail nor dimension shall be lost.

A measured quantity of the casting solution (an ethyl-silicate derivative) is poured into a rubber bowl. To this is added the catalyst. The setting time of the mixture is governed principally by the quantity of catalyst added; other governing factors being the age and temperature of the solution. This time may range from several seconds to two or three hours, depending on the type of work on hand, the average setting time being three minutes. The next stage is to mix the chemicals, add a quantity of refractory filler, and mix the mass thoroughly to a creamy consistency.

This self-setting slurry is then poured into the mould form. When set, the refractory mould is parted from the pattern and baseplate and placed on a metal grid. By applying a flame, such as that of a blowlamp, the mould is ignited, and this starts the liberation of alcohol from the chemical binder, which in turn changes the mould from a rubbery gel to a rigid body.

Moulds can be made consisting of one or any number of component parts, which, when

FIG. 1.—*Fume cupboard for initial "burning off" of moulds.*

assembled, will form the desired design. When the mould is cold, the parts are assembled and luted together, using again the refractory, casting solution and catalyst. Runner cups and risers of the same material are placed in position and luted to the mould. The mould is next placed in a muffle and baked at a minimum temperature of 700 deg. C. This drives off the remaining alcohol, and the mould is then ready to receive the metal.

Fig. 1 shows a section of the fume cupboard in which four moulds have been placed for "burning-off." Mould "A" is the drag-half for the production of a cast-iron die from which the customer intended to produce coat-hooks. B^1 and B^2 are parts of a stack-moulding set-up for casting small scale-hooks in an alloy cast-iron. The mould shown at C is for a stainless-steel sleeve. Note the vertical blowlamp for burning off this mould. Incidentally, blowlamps are used in this foundry because there is no available supply of town's gas.

Moulds

The moulds described earlier are highly refractory, having a fusion point of 1,700 deg. C. This enables high-melting-point alloys to be cast without danger of sand and metal fusion. High-temperature firing of the moulds renders them completely free from gas. The moulds are strong enough to withstand the inrush and outward and upward thrust of the metal, and, if desirable, they can be held by tongs during casting. Not only are the moulds strong, but they collapse easily under the pressure of the contracting metal, thus preventing "tearing" of the casting. The mould material is a slow conductor of heat, and, as a result, the casting cools slowly, thus relieving casting stresses.

Detail

Owing to the mould being heated before the pouring of the metal, there is no moisture nor are there any cold spots; reproduction of fine detail is thus possible. In moulds made from wooden patterns, the grain of the wood has been faithfully reproduced in the cast object.

Dimensional Accuracy

Because of the stability of the mould, castings can be produced having a tolerance of 0.005 in. per inch.

Metal

As a guide, the following metals have been cast: Non-ferrous alloys; cast-iron and its alloys; mild steel; alloy steels; austenitic manganese-steel; Stellite and Cobalide alloys. The weight of castings produced is dependent on the melting capacity available. Castings ranging in weight from $\frac{1}{16}$ oz. to 193 lb. have been made in the Author's foundry.

Personnel

The staff engaged and the present-day (August 1954) strength are as follow: A moulder responsible for all moulding and closing, and a metallurgist who supervises all metal melting, casting, and subsequent fettling operations. The African labour-force totals seven, comprising one moulder's assistant, three furnace attendants, two fettling operators and one general labour. The Author is responsible for the foundry management and sale of the products.

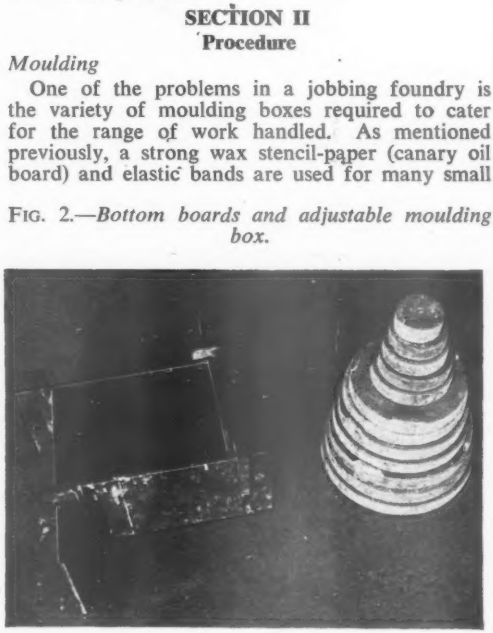
SECTION II

Procedure

Moulding

One of the problems in a jobbing foundry is the variety of moulding boxes required to cater for the range of work handled. As mentioned previously, a strong wax stencil-paper (canary oil board) and elastic bands are used for many small

FIG. 2.—*Bottom boards and adjustable moulding box.*



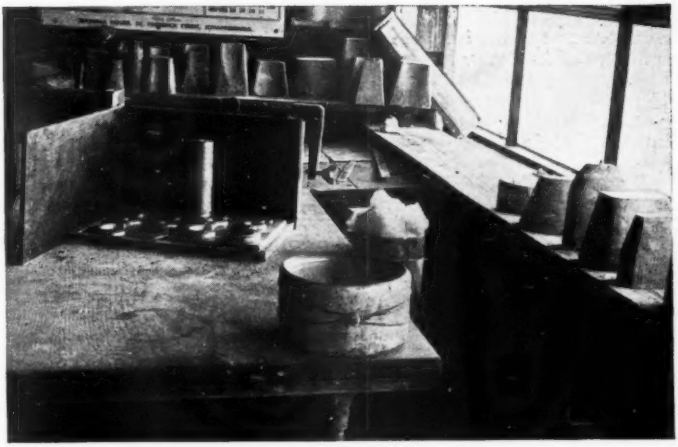


FIG. 3.—*Moulding section of P.D.L. Precision Castings (Pty) Limited.*

jobs. To provide some form of standardization, a series of circular bottom-boards was procured. Part of this set is shown in Fig. 2. The boards range in dia. from 1½ to 12 in. in steps of ½ in., and incorporate locating dowels.

An adjustable metal box for rectangular or square jobs is also illustrated in Fig. 2. The maximum dimensions of the box are 12 by 12 by 6 in. deep. For larger work, an adjustable wooden box provides for the making of moulds measuring up to 24 by 24 by 18 in. deep. This box is in three sections which enables the depth of mould to be either 6, 12 or 18 in.

The nature of the investment mould used, permits top pouring of 95 per cent. of the castings produced. This, naturally, simplifies moulding methods and three sets of riser pins, round, tapered and oblong, offer a wide selection for the work encountered. Fig. 3 is a close-up view of the moulding section of the foundry. The moulding board is hinged at the back, a device which serves two main purposes: First, it forms a simple but effective vibrating table (should this be required) for compacting the investment. Second, as it can be set at any desired angle in one direction, patterns which are thicker at one side than the other can be moulded at an angle, thereby reducing the quantity of investment required to fill the mould. Also illustrated in Fig. 3 are a selection of riser pins, half of the adjustable box, and a pattern plate for hooks.

Melting

Indirect-arc Furnace

The market research indicated that there would be a demand for small castings to resist abrasive and corrosive action. Non-ferrous extrusion dies in "Stellite" were requested by one potential customer. The Author instituted enquiries for the purchase of a small indirect-arc furnace suitable for this and similar alloys, but delivery periods of from 18 months upwards were offered for this unit. The manufacture of a furnace was therefore considered and actually completed in the foundry. The design finally arrived at is shown in Fig. 4.

Electrical Details:—The electrical unit (which was ex-stock) is a 17 kva welding transformer, manufactured locally, having variable tappings. For melting, the tapping is set at 347 v. 76 a., the choke at 195; the ammeter reading during furnace operation is 300. A 30-ft. trailing cable forms the connection between the main switch and transformer. For welding, or electric cutting, the transformer is removed from its furnace stand and set up at the welding bench. The tapping is altered to 380 v. 69 a. and the choke positioned according to the function required. The furnace electrode-clamps are water cooled by a gravity system from a 45-gall. tank. The 1-in. dia. electrodes are hand fed on a screw and parallel slides; both electrode holders are movable.

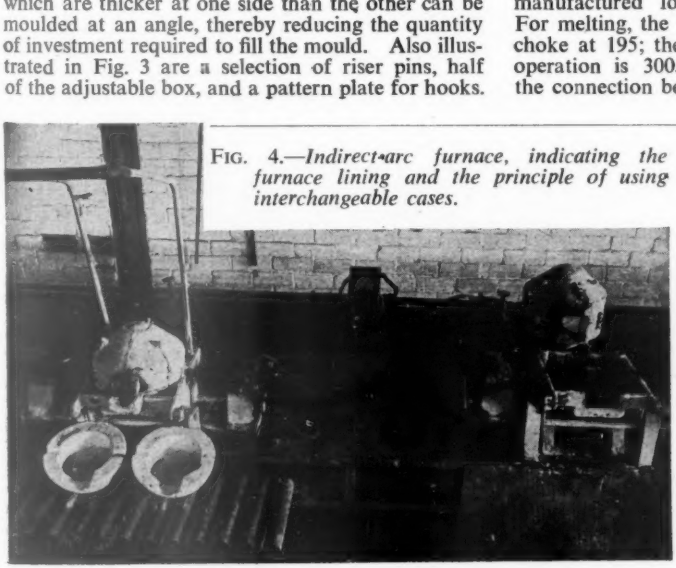


FIG. 4.—*Indirect-arc furnace, indicating the furnace lining and the principle of using interchangeable cases.*

Design Details:—The molten-metal capacity of the furnace is 15 lb. To avoid contamination of the metals to be melted, the body of the furnace is constructed as a separate unit. Several of these have been made, and, being identical, a change

from one to another is speedily effected. This point is illustrated in Fig. 4. The furnace is designed for hand rocking and to do this, a pipe 3 ft. long by 1¼ in. dia. is screwed to a bolt on the front of the frame. The pipe is unscrewed before tilting the furnace. The design also incorporates tilting on an axis in line with the lip of the pouring spout.

Refractory Lining:—The refractory lining is made by the same process and procedure as for moulding. Using a plaster-of-Paris mould, the shells produced are as shown in Fig. 4 and have an i.d. of 8¼ in., the o.d. being 10½ in. The shells are supported in the furnace body by six bolts, three on top and three at the bottom; the bolt heads being on the outside of the body, thus provide a means for adjustment of the shells.

When the shells are fixed, vermiculite is poured through a hole in the top of the casing, and this fills the gap of ¼ in. between the o.d. of the shells and the i.d. of the metal body. The hole is then sealed with moulding refractory.

Operation:—Fig. 5 indicates the line-up of three furnaces, as well as some moulds arranged on a roller conveyor, in front of furnace No. 1. A turntable is used when pouring large quantities of small moulds. To commence the melting procedure, the furnace lining is preheated by the arc for a period of 15 min. The charge is then loaded through the mouth opening in front, this opening serving for both charging and pouring. A refractory plug placed in this mouth prevents loss of heat and radiation of the arc rays. Starting from cold, a period of 40 min. is the normal time before the first melt of 15 lb. can be tapped. Subsequent melts can be tapped in 25 to 30 min.

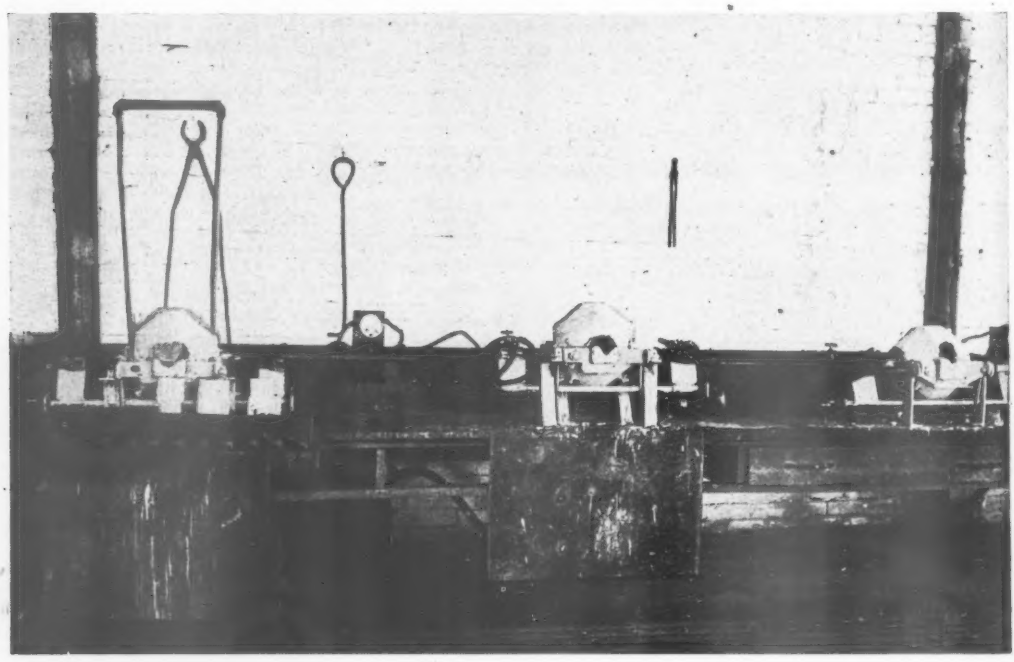
To conserve lining life and ensure continuous production, it has been found beneficial to operate the furnaces alternately. The procedure, therefore, is to commence a melt from No. 1 furnace. At the conclusion of that melt, the leads are changed over and No. 2 furnace is preheated and charged. Meantime the third charge is loaded into No. 1 furnace and the residual heat of the furnace preheats this charge. The average lining life from this furnace is 1,500 lb. or 100 melts of full capacity.

Forced-draught Pit Furnaces

The foundry had not been long established, when it was evident that the advent of the uranium-extraction plants on the gold mines was creating a demand for 18/8 stainless-steel castings. This, coupled with other demands, led to an order being placed with an overseas firm for an electric furnace suitable to melt this alloy. After a waiting period of 12 months, the equipment was received but proved to be entirely unsuitable in service. This placed the firm in the position of having orders on its books with no apparent means for their fulfilment.

Included in the purchase of the foundry premises, were two forced-draught coke-fired pit furnaces. These were being used for the production of alloy

FIG. 5.—*General view of the battery of indirect-arc furnaces.*



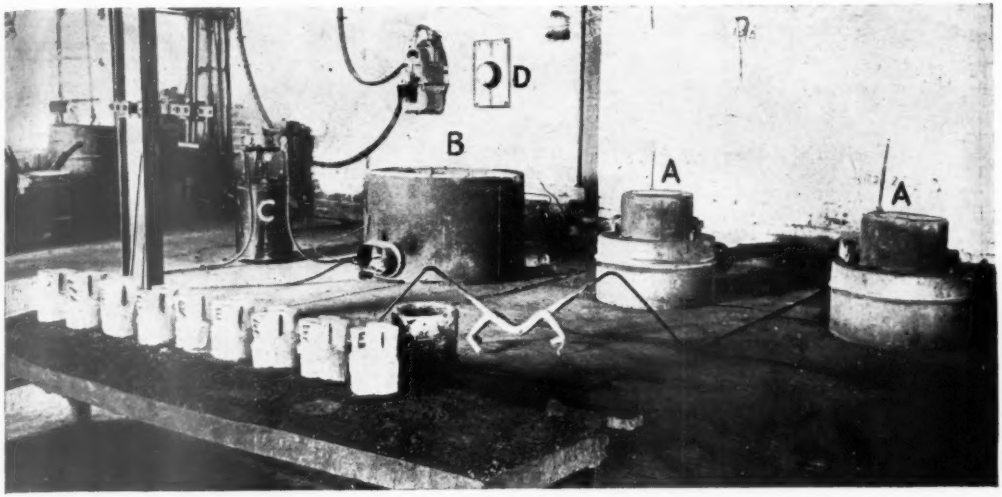


FIG. 6.—*Pit-fired crucible furnaces and mould baking oven.*

cast-irons and non-ferrous alloys. Fig. 6 shows the two furnaces, A, A, the air for which is supplied through a 4-in. dia. pipe by a 2.5 h.p. motor-driven fan. The blast entry is at the top of the shell and the supply then passes downward—being preheated on the way—to enter the furnace under the fire-bars. The furnace is bricked to an internal diameter of 18 in. and is 24 in. deep.

Tests were conducted on the melting of stainless-steel (18/8) scrap in these furnaces. They proved that, using best-quality plate scrap, amounts of up to 30-lb. charges could be successfully melted.

As was to be expected, the carbon increased considerably, the final result being in the region of 0.4 per cent. Mechanical tests on the metal gave the following results:—

Tensile, tons per sq. in.	Yield, tons per sq. in.	Elongation, per cent.	Reduction in area, per cent.
34	26	10	10
36	30	10	13
40	30	15	15
33	29	8	8
38	30	10	15

A tentative approach to the customers requiring the stainless-steel castings, with an explanation of the quandary and proposed solution, produced favourable results; castings were made and supplied to them for testing.

Up to the present time, over a period of 2½ years, 30 tons of alloy steel in the 18/8 range have been melted, producing some 1,500 castings, 90 per cent. of which were pump parts, working under corrosive and abrasive conditions. So far, only two have failed in service, these being from one of the very first melts. The castings have ranged in weight from 4 oz. to 63 lb., the heaviest being a die block for the forging of bicycle axles. One interesting application of this metal is the produc-

FIG. 7.—*Thermit casting equipment.*

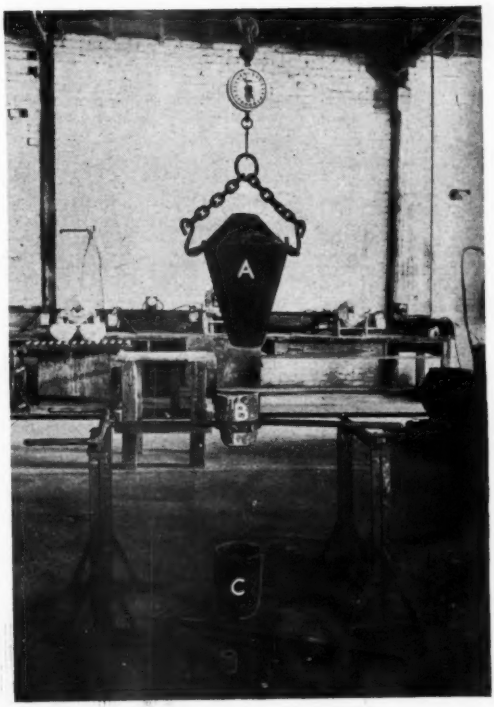


FIG. 8.—*Exothermic sleeve "set-up."*

tion of mitre wheels for use on the driving shaft of a reaping combine for maize.

The maximum weight of metal produced for one cast was 93 lb. and this was attained by melting 46½ lb. in each of the two pots. To speed the melt and achieve fluid metal, an addition of Thermit mixture was made prior to withdrawing the crucibles; (additional alloying-elements were added previously to compensate for the loss incurred by this procedure). The maximum production for one day (9 hrs.) has been six casts of 55-lb. each, giving a total of 330 lb.

Obviously, this is by no means the most efficient method of producing alloy-steel castings, and arrangements are now in hand for the installation of a suitable furnace. The results, nevertheless, have been remarkable, and the fact that the castings have a high carbon-content has in no way reduced their service life. In point of fact, it has been recorded that these castings have in several instances outlasted castings which were correct to specification.

Muffle Furnace

A problem arising directly from the production of alloy-steel castings was that of securing proper heat-treatment. Enquiries were subsequently instituted to procure a furnace which would be suitable for the heat-treatment of castings up to temperatures of 1,100 deg. C., and the baking of moulds at a temperature of 900 deg. C. Unfortunately, delivery promises and economic considerations indicated that it would be necessary to utilize a "home-made" item.

The furnace construction is indicated at "B," Fig. 6. It is of 2 ft. 6 in. i.d., and has a depth of 2 ft. The latter dimension can be increased at will, merely by the building up of successive layers of firebrick. Charging is, of course, carried out from the top. The heating unit is shown at "C" in Fig. 6; this is known as a paraffin preheating tank and has been specifically designed for the preheating of metal sections to be welded by the Thermit process.

The tank has a fuel capacity of 5 gall. Compressed air, passing through a butterfly valve, is supplied to the tank at a constant pressure of 30 lb.

FIG. 9.—*General view of the fettling shop.*

per sq. in. The air and paraffin mixture passes through two needle valves at a pressure of 10 lb. per sq. in., and this mixture is introduced through ports in the bottom of the furnace wall. Starting from cold, with a full load of refractory moulds, the furnace reaches the required temperature of 900 deg. C. in 2½ hrs., the temperature being recorded with a thermocouple, attached to the indicator shown at "D" in the illustration.

When heat-treating of castings is carried on, the temperature of 1,050 deg. C. can be attained without any difficulty, and the fine control of the needle valves ensure the temperature being maintained within 5 deg. C. A full tank of paraffin has sufficient fuel to operate for 5 hours. The only parts of the equipment which require attention are the atomizer burners, and these are cleaned daily. In the 2½-years of operation, this furnace has not required any maintenance other than the replacement of the roof, which, incidentally, is a monolithic slab, as used for the roof of pit-fired furnaces.

Casting of Mild Steel

Due to the set-back with the melting furnace for steel, the firm was having difficulty in supplying mild-steel castings—a difficulty satisfactorily overcome by the adoption of the Thermit process of casting. This subject has been fully described in a previous Paper[3] by the Author, and only a brief summary of the procedure will be included here:—

Thermit powder is a mixture of finely-divided aluminium powder and iron oxide. Alloying additions may be made to produce a steel other than

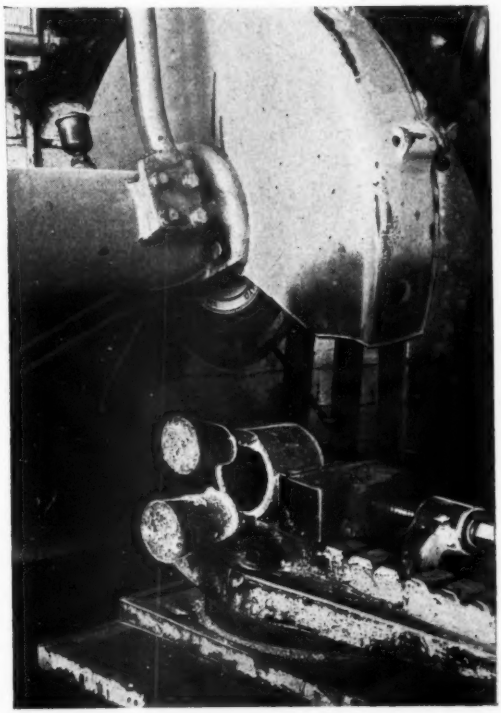
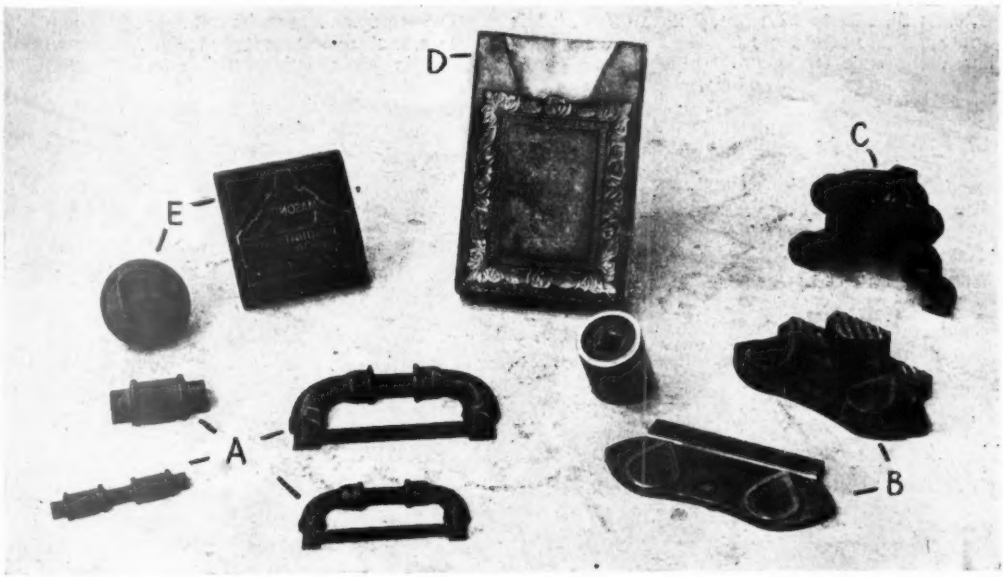


FIG. 10.—*Abrasive-wheel cutting-off machine.*

FIG. 11.—*Selection of castings made at the foundry described.*



FIGS. 12 and 13.—*Further selection of castings:* A, *a mild-steel delivery valve;* B, *a pipe-bending die and C, a worm-wheel in Ni/Cr/Mo cast iron; Fig.* 13 *(below)—Shows castings produced in the smaller weight range.*

mild steel. One typical analysis is as follows:—C, 0.20; Si, 0.23 to 0.27; Mn, 0.65 to 0.7; P, 0.035; and S, 0.02 to 0.04 per cent. This particular steel has an ultimate tensile-strength of 25 to 28 tons per sq. in.

The equipment required to produce a 20-lb. charge of steel is illustrated at Fig. 7. The crucible "A" being the reaction crucible and "B" the cruc-

FIG. 14.—*Investment-cast medals.*

ible to receive the metal as it flows from the reaction crucible. Crucible "B" is also used to pour the metal into the moulds. The slag crucible is shown at "C."

Preparation.—To prepare for a cast, all three crucibles are warmed to ensure that moisture is completely removed. A magnesite thimble is seated in the base of the reaction crucible; a tapping pin is then placed through the aperture in the thimble, with the large head covering the opening, and the stock projecting some 2-in. beyond the bottom of the crucible. An asbestos washer and some plugging material (ground slag) are then placed on top of the pin and this effectively seals the tap-hole. Next, a weighed quantity of Thermit is poured into the reaction crucible. An indentation is made on top of the mixture, and into this is placed a small amount (sufficient to cover a sixpence) of barium-peroxide. This is the ignition powder; to act as a starter, three or four match-heads are placed in this powder. The crucible cap is set on the reaction crucible, and the whole is then ready for a cast.

Reaction.—The reaction is commenced by applying a blowlamp flame to the match-heads; these, in turn ignite the ignition powder which starts the reaction of the Thermit powder. A computed temperature of 2,800 deg. C. is reached in the reaction crucible, and in 20 sec., the separation of slag and metal (50 per cent. by weight of the Thermit powder charged) is complete. The flat-ended bar (shown in the illustration and known as the tapping spade) is used after 25 sec. to strike the tapping pin smartly in an upward direction. The molten steel then flows into the receiving crucible. Careful observation will determine the change in colour from metal to slag and at this moment, the receiving crucible is moved aside to permit the slag to flow into the pot "C".

For the purpose of accurately determining the metal/slag demarcation, a Salter scale is used in the Author's foundry; this is illustrated at Fig. 7. By prior calculation and subsequent observation of the scale, the receiving crucible can be removed before slag enters the metal. The metal thus produced is of accurate composition, free from gas, and very fluid. The observed temperature of the metal flowing from the reaction crucible is 2,200 deg. C. Due to this high temperature, the normal procedure is to have a waiting period of 2 min. before pouring the metal into moulds.

Exothermic Sleeves

The immediate problem of steel production was apparently solved by the use of the pit furnaces and Thermit casting. Customers, however, continually requested the supply of larger castings, which were outside the scope of the firm's equipment. In the stainless-steel field, the melting capacity was limited, and in the case of Thermit castings, economic considerations were often the limiting factor. A solution to this problem was sought in the adoption of exothermic feeding-sleeves.

The low ignition point of the exothermic-sleeve material, however, presented a problem, as many of the moulds were to be heated to a temperature of 600 deg. C. before casting. This problem was

FIG. 15.—*Architectural castings produced by the investment technique.*

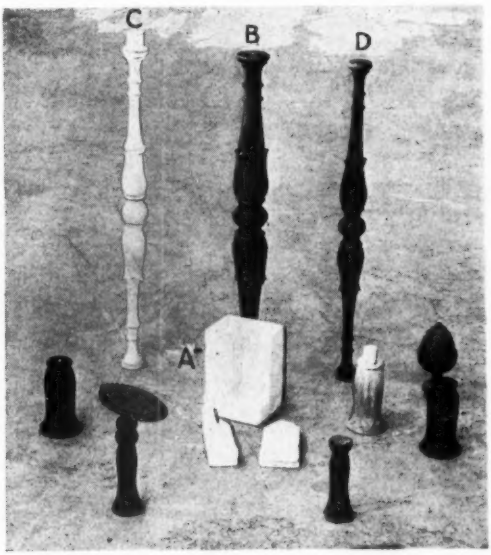


FIG. 16.—*Architectural castings assembled to form ornamental balusters.*

(Courtesy E. J. Loerincz (Pty.) Limited.)

solved by the set-up illustrated at Fig. 8. Using the corebox "A", a refractory cup was made, having the form shown at "B." After the cup had been baked in the normal manner, the wooden pin and skeleton corebox "C" were placed in position and the exothermic sleeve rammed *in situ*; the final appearance being shown at "D" in the illustration. The sleeve was then dried at 200 deg. C.

When a mould was made to incorporate this sleeve, the rise pin "E" was placed in position on the pattern. The recess thus formed enabled the refractory cup to be accurately registered in the mould top immediately prior to casting. A mixture of silica sand and 4 per cent. phenolic resin was then poured around the joint of the cup and mould top, sealing the slight gap between the two faces. The exothermic sleeve thus formed was 2¼-in. o.d. by 1⅜-in. i.d., by 5 in. long. This particular size proved satisfactory for the complete range of work handled in the foundry. Where extra feeding was required, more than one sleeve was used. Casting/molten-metal yields of as high as 90 per cent. were frequently recorded, in both non-ferrous and ferrous alloys.

Fettling

The fettling shop of the foundry occupied a very small area of the factory floor; being only 225 sq. ft. A general view of this corner is shown in Fig. 9. The only item of equipment worthy of mention is the abrasive-wheel cutting-off machine. This machine can be seen in the background at "A" and a close-up view of the work area is illustrated in Fig. 10. The variety fo work handled by this machine has ranged from a stainless-steel valve-seat, 27-in. dia., to a "Stellite" extrusion die ½ in. dia. In order that this range could be handled, an old drilling machine was brought into service; the table being used to carry the vice. With this device, the work table could be raised, lowered, rotated and swivelled in any desired direction. The cutting disc used is

FIG. 17.—*Ornamental figures for the bank doors.*

(Courtesy W. de S. Hendrikz.)

FIG. 18.—*Bank doors, with the castings mounted in position.*

14 in. dia. by ⅛ in. thick and its driving spindle has a speed of 5,000 r.p.m. As an indication of the cutting speed, a stainless-steel riser, measuring 2½ in. by 1½ in. can be cut in 20 sec.

SECTION III—TYPICAL PRODUCTS

A selection of castings produced in the Author's foundry is shown in Figs. 11-18. Included in Fig. 11 are some patterns, "A," made for shell-moulding patternplates. Two patterns for a moulding-machine patternplate are shown at "B," and "C" is a piston half-corebox. This latter was made from a wooden pattern. The intricate die-cavity at "D" was made in close-grained cast-iron. The two branding-dies at "E" are interesting, in that they were cast in Stellite, reset into a refractory mould, heated to a temperature of 1,000 deg. C. and then had stainless-steel element-holders cast on to them. The Stellite castings had dovetails cast on their reverse side, and this provided a key for the stainless-steel element-holder. The Stellite portion of the larger branding-die shown weighed 8 lb.

Of particular interest in Fig. 12, is the sectioned casting shown at "A." This is a delivery-valve casting, in mild steel, produced by the Thermit process. The casting weighed 11 lb. 8 oz., and, using—an exothermic sleeve—15 lb. of metal was required to cast the job successfully. The pipe-bending die shown at "B" was cast in Ni/Cr/Mo. cast-iron and weighed 93 lb. The worm-wheel, shown at "C," was cast in the same metal and weighed 27 lb. and the castings produced were within 0.010 in. of the drawing size.

On the right hand side of Fig. 13 are shown some Stellite dies for non-ferrous extrusion, a wire guide and milling cutter. The items indicated at "A" were produced by the Thermit process and the tension lever at "B" was cast in GMI. Through utilizing investment-casting for this piece, 14 machining operations were eliminated.

Fig. 14 shows a good example of the detail which can be reproduced by investment casting. The medal, the reverse sides of which are shown, was cast in bronze and the small medal in gold. This latter was for presentation to an important personality in the South African political field.

One very interesting architectural job undertaken by the foundry is illustrated in Figs. 15 and 16. The items to be cast were balusters, ordered in cast-iron. As a considerable amount of fluting was incorporated in the design, the lost-wax process of casting was undertaken, an inexpensive, fully-refined wax being obtained locally. Carved wooden patterns were used for the production of plaster piece-moulds, one of which is shown at "A," Fig. 15. The plaster-of-Paris piece-mould was assembled, soaked well in water and the wax poured in under gravity.

After a period of some 20 sec., the mould was inverted, and the unsolidified wax poured off. This prevented the formation of shrinkage cavities in the wax models and facilitated the removal of the wax from the investment moulds. The removal of the wax from the plaster was also simplified by the fact that the plaster was very wet. The main baluster shown at "B" in Fig. 15 is 22 in. long, and weighed 13 lb.; the wax model for the secondary baluster is shown at "C" and the casting at "D"; part of the final assembly has been reproduced in Fig. 16.

The four figures shown in Fig. 17 are part of another interesting architectural job. The ploughman shown on the right hand side measured 22 by 17 in. and had an average thickness of ¼ in. All the figures were the same thickness and were cast in phosphor-bronze. Thirty-six figures in all were cast for six doors, ultimately forming the main entrance to a bank. One complete pair of doors is shown in Fig. 18.

Conclusion

In a "young" country like South Africa, launched into industrial expansion, but remote from the highly-industrialized countries in the Northern Hemisphere, the foundryman may be called upon to exercise more ingenuity and perseverance in the face of difficulties than the foundryman in a

A Jobbing Investment Foundry in South Africa

well-developed country. For this reason, it is hoped that this Paper may act as an encouragement to those who encounter obstacles in production which, from reasons of economy or distance, cannot be solved by the simple expedient of ordering and installing the suitable equipment.

Acknowledgments

The Author wishes to record his thanks to Shaw Processes, Limited, Newcastle-upon-Tyne, England, for permission to publish details of the "Shaw" process of moulding, also to the directors of Rely Products (Pty.), Limited, Johannesburg, for their consent to the publication of this Paper.

REFERENCES.

[1] British Patent No. 622459, May 8, 1949.
[2] Shaw Process of Precision Casting, *Machinery*, Oct. 2, 1952.
[3] Steele, John, "Thermit Casting," *Proc.*, Inst. Brit. Foundrymen 47. B 29.

Chimneys and Dispersal of Smoke

To avoid parts of a smoke plume being blown rapidly to ground by local disturbances of the wind, it is necessary to choose minimum heights of chimney and exit velocities of flue gases which are related to the height of surrounding buildings, diameter or chimney, and local ground contours. Even when the smoke avoids these disturbances, part of it, considerably diluted, reaches the ground at distances beyond about six times the effective height of the chimney. This effective height is the sum of the actual height and a function of the temperature, volume, and velocity of the gases at the mouth of the chimney.

Theoretical formulae which have been developed for the calculation of smoke concentration at ground level at any distance from the chimney and the rate of dust and grit deposition are discussed by J. E. Hawkins and G. Nonhebel, in a paper presented to the Institute of Fuel. The formulae are given in a form suitable for use by design engineers, together with the supporting evidence from direct measurements. The agreement is sufficiently good for most design purposes. The meteorological background of the problem is described in an appendix.

Increased Membership of GTMA

Membership of the Gauge and Tool Makers' Association has increased during the past session and now stands at 320 British firms, states the annual report, which was presented at the annual general meeting of the association on November 9.

The report says that the GTMA Council has accepted a recommendation that the organization should provide an incentive for young men wishing to make their careers as skilled draughtsmen and designers in the industry by the award of a certificate of gauge and tool design and draughtsmanship. Applicants for the award must have served a *bona fide* apprenticeship with a member of the Association and have obtained a Higher National Certificate in mechanical or production engineering, or its equivalent.

WICKMAN, LIMITED, have now established an area office in Nottingham, which will be under the control of Mr. E. J. Swinn at 36, Market Street, Nottingham.

French Metallurgical Development

The annual autumn session of the French Metallurgical Society in Paris is now a recognized meeting place for metallurgists from most European countries. This year was again up-to-standard as regards numbers of participants and contributions from France, Britain, Germany, Belgium, Italy and Switzerland. Mr. Raoul de Vitry, president of the *Société Française de Métallurgie* welcomed members and visitors on October 24, and reviewed the programme for the week. Some 150 people were present at this official opening.

The president then presented the Osmond medal of the Society to Mr. Pierre Chevenard for his contribution to French metallurgy. Mr. Chevenard was, until recently, scientific director of the S.A. de Commentry-Fourchambault et Décazeville. The Rist prizes, given yearly as incentives to the younger generation of metallurgists, were this year received by Mr. Pierre Lelong of the Tréfileries et Laminoirs du Havre and Mr. Philippe Galmiche, research worker at O.N.E.R.A. Mr. Chevenard then gave a paper on the development of Osmond's work on thermal analyses of metals and metallurgical research.

On the afternoon of October 24, and on subsequent days, technical sessions were held simultaneously in two lecture theatres at the *Salle de la Chimie*. Visits were organized to the French Mint and the *Institut de Recherches de la Sidérurgie* (the French counterpart of BISRA). A banquet was held on the Wednesday evening at the *Cercle Interalliée*.

Foundry Paper

At the technical sessions, the single paper devoted to purely foundry practice is summarized as follows:

The Mechanism of the Formation of Spheroidal Graphite in relation to the structure of the metallic matrix was discussed by Scortecci, Durand and Venzano (Italy). They attempted to formulate a hypothesis for the "birth" of graphite nuclei and their growth based on results of experiments. They prepared small bars of nodular iron in 12-lb. high-frequency furnaces. To obtain spheroidal graphite, they employed a nickel-magnesium alloy in order to obtain irons in which chemical heterogeneity was evident as a result of the presence of nickel. Heterogeneity was illustrated during the lecture by colour metallography. On samples of as-cast material, they determined the mean quantity of nodules, the mean size and their disposition. The samples were then given thermal treatments of long duration followed by very slow cooling. After this, the workers noted the appearance of small nodules in zones where microscopic examination of the as-cast material had failed to show any graphite.

British Standard Revised

Aluminium and aluminium-alloy ingots and castings for general engineering purposes (*B.S.* 1490: 1955)

The British Standards Institution announces the publication of a revision of the above standard, which was first issued in 1949. The revision introduces four new alloys. Alloys L.M.17 and L.M.19, which were included in the original edition, have been omitted. Some of the alloys have been included in conditions not previously covered. And a number of amendments have been made to the chemical compositions and mechanical properties of the other alloys. Copies of this standard may be obtained from the British Standards Institution, sales branch, 2, Park Street, London, W.1. Price 10s. each.

Metal and Mould Research on Steel Castings*

Discussion of the Congress Paper by Dr. J. A. Reynolds and Professor A. Preece (Part I) and Mr. J. M. Middleton and Dr. J. White (Part II).

The discussion covered fairly well the subject matter of both parts of the Paper. Initially, optimum feeder-head design was dealt with, then the effect of gases and the relative significance of different types of steel structures. The application of simulated "life" tests for bentonites was referred to, both orally and in written comment. Other remarks concerned comparisons between the research reported and similar work in the non-ferrous field and between resin-bonded and oil-bonded cores—the latter mainly from the point of view of resistance to moisture pick-up.

Mr. H. J. V. Williams, senior vice-president of the Institute, took the chair for the discussion on the general subject, "Metal and Mould Research on Steel Castings," at the International Foundry Congress, last June. The Paper had been given in two parts: Part I, "Solidification Mechanism," being presented by J. A. Reynolds, B.SC., PH.D., and Professor A. Preece, M.SC., PH.D., F.I.M., and Part II, "Mould- and Core-bonding Agents," by Mr. J. M. Middleton, A.I.M., A.MET., and J. White, D.SC., PH.D., F.I.M.

Optimum Feeder-head Shape

Opening the discussion, DR. D. V. ATTERTON, Birmingham, congratulated the Authors on two stimulating contributions. He wished to confine his comments to the first section by Dr. Reynolds and Prof. Preece, which contained several controversial points. On page 3 and page 8 of the preprint of the Paper, it is stated that the most suitable form of head for efficient feeding is the narrow "chimney type" with a volume-to-surface-area ratio exceeding that of the part of the casting to be fed by about 20 per cent. This statement was evidently based on the trials carried out on the 80-lb. and 10-lb. castings illustrated in Figs. 2 and 3, respectively. He considered that these castings were non-representative of practice, particularly as no form of surface covering on the feeder heads had been employed—this had resulted in a marked columnar layer in the upper region. The conclusions based upon these trials were also seriously open to doubt.

From theoretical considerations, it was obvious that there would be an optimum diameter for greatest thermal efficiency of the feeder heads which would depend on the relative heat loss through the walls by conduction and the heat loss by radiation from the surface. The heat loss by radiation from the exposed surface could be readily reduced by using materials such as normal floor sand, good insulators, hot-topping compounds and exothermic covers, probably in that order of increasing efficiency. However, even if such feeder-head coverings were not used, feeder heads with a diameter-to-height ratio greater than indicated in the Paper would be preferable.

Dr. Atterton described a few of the results which have been obtained by his colleagues, notably Mr. D. H. Snelson, and which had considerable bearing on this Paper. Fig. A showed three heads of substantially identical volume, namely, a 35 per cent. feed, which had been lined with exothermic materials. These three heads illustrated the transition between the type of shrinkage observed in practice. In the tallest head, the region of unsoundness extended down the head and into the casting itself; the middle head showed a transition-type of piping, whereas the squat head showed a level flat feed. This transition had been noted first by Mr. Snelson, who had carried out an extensive investigation into various methods of feeding. The results of his investigations were described to the Sheffield branch of the Institute early in 1954.

Exothermic Feeding

With particular reference to exothermic feeding, trials had been carried out to determine the critical diameter of head required to obtain a sound casting. Fig. B illustrated some of the results schematically; thus, with heads of a diameter which gave the transition-type of feed, increase of height was advantageous in that it raised the area of shrinkage out of the casting. With the narrow type of heads, increase of height did not influence the shrinkage pattern, whereas with the squat heads, where a level feed had been obtained, increase of height simply increased the amount of sound metal in the head.

This transition in type of shrinkage was obviously due to the mode of solidification in the head. With the tall, narrow heads, heat loss through the walls by the conduction predominated and the heads were solidifying radially so that feed metal for the casting was supplied by the core of liquid metal in the centre of the head. With the squat type of head, directional solidification occurred and the whole of the metal in the head was available for feeding, since solidification on the walls had been sufficiently delayed. Obviously, these results could be varied depending on the thickness of exothermic materials surrounding the feeder head and on the efficiency of the cover on the surface of the head.

Fig. C illustrated the results obtained on a range of spindles fed with exothermic heads of varying diameter. These results had been obtained under production conditions. It was interesting to observe that the critical ratio of diameter of the exothermic

* Paper printed in the JOURNAL, July 14 and 21, 1955.

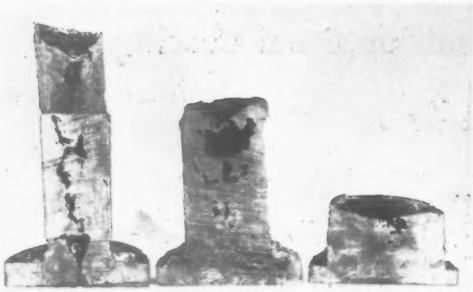


FIG. A.—*Steel feeder-heads of varying diameter: height ratio and of identical volume, produced in exothermic sleeves: note the transition in the form of shrinkage.*

head to the diameter of the spindle increased with the spindle diameter; thus a 3-in. dia. head was sufficient to give a flat feed on a 4-in. dia. spindle but, for a 20-in. dia. spindle such a result was not obtained until a head diameter of about 22 in. was used. This result obviously had some considerable bearing in roll production.

This investigation had so far only been extended to plates and there, once again, as shown in Fig. D, much the same type of result was obtained. With the small-diameter heads, irrespective of their height, one obtained unsound feeding, but eventually, when the diameter attained its critical value, a flat type of feed occurred. Dr. Atterton considered that these results were, in many ways, a direct contradiction of those obtained by Dr. Reynolds and Professor Preece and looked forward to having their comments.

Replying to these points, DR. REYNOLDS said that his comments could not be very constructive because of the considerable difference between his experimental conditions and those obtaining for Dr. Atterton's work. Dr. Atterton had used exothermic heads, whereas Professor Preece and himself were concerned solely to study the influence of feeder-head design from which the effects of exothermic sleeves, feeding powders and other artificial feeding aids were specifically excluded.

The assessments of feeder height and cross-section which Dr. Atterton had criticized were based only on the 18 castings described. The assessment was not mathematically precise, but was based on a careful evaluation of the three factors of greatest concern to the foundryman, namely:—(1) Maximum metal economy—"yield"; (2) freedom from gross shrinkage unsoundness; and (3) attainment of the best combination of mechanical properties. These factors had to be carefully balanced: for instance, the best mechanical properties were obtained with a yield of only 22 per cent., but he asked in how many cases could this low figure be economically justifiable. From the results, it was clear that the most economical way of combining good mechanical properties with freedom from shrinkage pipe, was to use the C2 or C3 type of head—shown in Figs. 2 and 3.

Dr. Reynolds pointed out the close relationship between the V:A ratios of the feeder-heads and the depths of shrinkage pipe recorded in Table I. This indicated that piping could be excluded from the casting if the V:A ratio for the feeder-head exceeded that for the casting by about 20 per cent. This figure agreed with that reported by Nicholas to the 1953 International Foundry Congress. Short of using a sphere, the most economical way of fulfilling this condition was by using a fairly tall cylindrical head with a cross-section little greater than that of the casting.

Effect of Gases

A written contribution, sent in by DR. J. T. BERRY of the Naval Construction Research Establishment, Rosyth, was then read by Prof. Sarjant, director of the British Steel Castings Research Association. In it the writer stated he agreed as to the difficulty of applying certain undercooling and temperature gradient mechanisms to explain the "zones" occur-

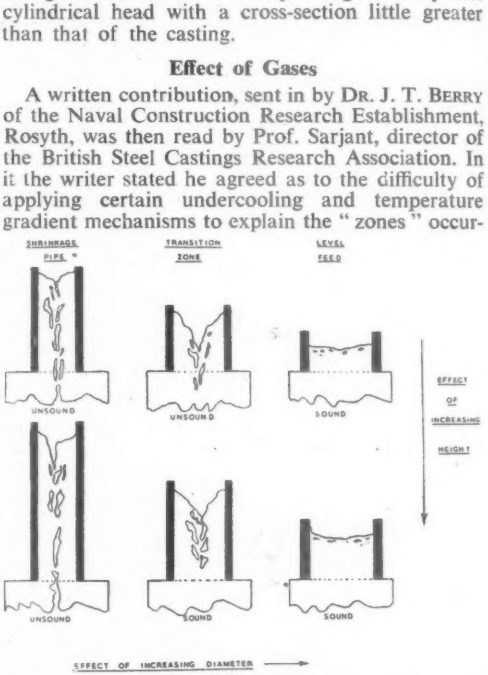


FIG. B.—*Influence of height: diameter ratio of exothermic feeding-heads on the form of shrinkage cavities (schematic).*

ring in steel castings. However one point of interest arose when the results expressed in Fig. 5 were compared with the results of Polin. (I. V. Polin, *Stal*, 1948, No. 1, p. 55.)

It had been suggested that certain dissolved gases, in the main hydrogen and nitrogen, had an effect on the mode of crystallization of steel castings and ingots. Several workers had provided evidence of that:—*viz.* Franks, *Iron Age*, 1933, No. 10; Bennek & Muller, *Stahl und Eisen*, 1935, No. 12, p. 321; Hohage & Schaffer, *Arch f. Eisen*, 1939, **13**, No. 3, 123; and C. Zappfe & R. Sims, *Trs.* A.F.A., 1934, **51**, 517, as well as Po'in.

Polin, using a vacuum melting and casting technique where necessary, had shown that a variety of the possible combinations of structures (*i.e.*

equiaxed, columnar, nuclear) resulted by allowing the steel to solidify in various atmospheres. Atmospheres of hydrogen alone, at pressures of 0.2 to 0.3 atmospheres, were seen to increase the grain size and to "elongate" the equiaxed grain shape when compared with ingots solidifying *in vacuo*. Water-vapour admitted to the apparatus and having a total pressure of 0.2 to 0.3 atmospheres was seen to allow the appearance of all the three types of structure. It was interesting to note that for three pouring temperatures (1,580, 1,540, and 1,495 deg. C. (liquidus *c.* 1,490 deg. C.)) ingots solidifying *in vacuo* had fine equiaxed type structures.

He questioned whether such an effect had possibly been in operation for the castings illustrated in Fig. 5, in addition to the "shower" type mechanism of "nucleation" upon inherent nuclei, as it was obvious that in the absence of degassing technique, hydrogen might possibly be present in amounts that would increase with pouring temperature.

The dependence of mode of crystallization on casting size brought to mind the recent work of

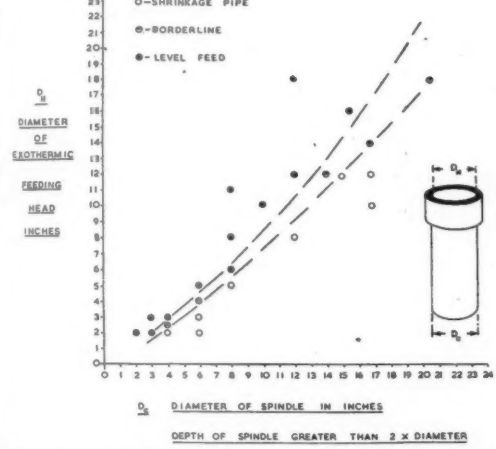

O-SHRINKAGE PIPE
⊖-BORDERLINE
●- LEVEL FEED
DIAMETER OF EXOTHERMIC FEEDING HEAD INCHES
DIAMETER OF SPINDLE IN INCHES
DEPTH OF SPINDLE GREATER THAN 2 x DIAMETER

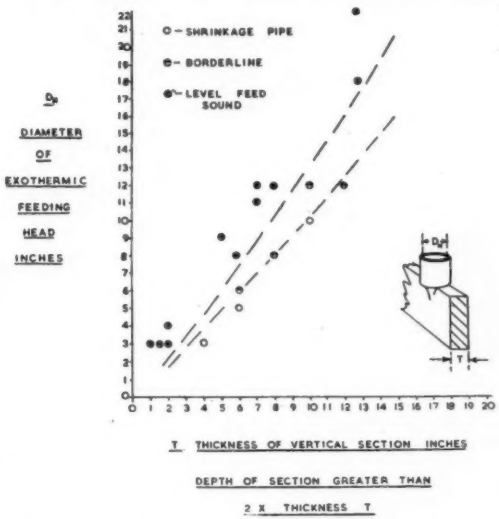
FIG. C.—*Relationship between critical diameter of exothermic feeding-heads and diameter of spindles.*

Morris, Tiller, Rutter & Winegard, *Trs.* A.S.M., 1954 (preprint), 9 pps., if one considered casting size made manifest as solidification rate. Those workers had shown that where for a particular alloy a certain value of the ratio of solidification rate to temperature gradient at any point in a casting was exceeded, columnar-type growth occurred. It was interesting to note that that was one of the first hypotheses involving the variable time.

Nuclear Structures and Porosity

MR. B. GRAY agreed that nuclear structures were difficult to feed, but suggested that the microporosity found in the nuclear crystallization in that case was not an inherent trouble in that type of structure, since in the horizontal castings investigated by the BSCRA Panel when it was part of BISRA the elongation and reduction of area in test-pieces from nuclear structures were found to be almost identical with those having columnar structures. Only the maximum stress was lower and very similar to the results reported in the present Paper. Further, makers of aircraft castings used very long heads, with the deliberate object of causing a nuclear structure in the casting below and they were not likely to do that for such work if ductility was going to be impaired. The trouble in the case reported must be attributed to the position of the test-piece across the middle of the casting and the microporosity was caused by the incipient centre-line shrinkage.

He also asked how the dendrites could be remelted from equiaxed crystals to form nuclear crystals in Samway's first casting, since the casting was poured at the liquidus temperature. On the question of convection currents, he enquired what evidence there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T THICKNESS OF VERTICAL SECTION INCHES
DEPTH OF SECTION GREATER THAN 2 X THICKNESS T

FIG. D.—*Relationship between the critical diameter of exothermic feeding-heads and section thickness of plates.*

was that convection ceased at such an early stage as had been stated.

Replying first to Mr. Gray's point about nucleation in a steel casting poured at the liquidus temperature, DR. REYNOLDS said that Dr. Samway's practice was, as far as he knew, to melt in a high-frequency furnace and deoxidize with aluminium, following which the metal, considerably superheated, would be allowed to cool in the pot to the desired casting temperature. He had said that convection currents ceased when the "casting" attained thermal homogeneity and he had been reminded that convection had persisted for 20 min. in some experiments with small "wax" castings. That was true. These statements were not incompatible; the lengthy period needed to attain homogeneity could be

judged by the fact that a block of wax 7-in. long by 3½-in. square required seven hours to freeze.

Dr. Reynolds confirmed that tall heads did in fact refine the nuclear structure—not apparently a desirable characteristic. He pointed out, however, that the columnar skin was enlarged and this might be a good reason for the effectiveness of tall heads.

MR. I. C. H. HUGHES, of the British Cast Iron Research Association, said he found the castings which Dr. Reynolds had made and which were described in Figs. 2 and 3, very interesting. He would like to make a few remarks based upon his observations of steel castings and some experiments on iron castings. The feeder heads which Dr. Reynolds described as being most successful were incidentally also those which had the smallest top surface-area. Those castings were, he understood, made in open-top moulds. He thought that sufficient consideration was not usually given to the extremely great effect of open metal surfaces in producing rapid solidification, and he noticed that in all those illustrations there was a very strong columnar zone extending downwards from the top surface of the casting. He wondered whether rather different results might have been obtained, if the castings referred to had been made in closed moulds with a sand top.

Experiments on iron test-block castings had indicated that when an open-top feeder was used microporosity was often present in the castings, whereas the use of a closed (sand) top eliminated this defect. As with Dr. Reynolds' casting, an open top had resulted usually in a solid casting having a flat-top feeder with thick columnar zone extending below. From the feeding point of view such a zone represented waste metal. With a closed top, however, sinking or piping of the head became evident, and the columnar zone below the upper surface was decreased. He thought that perhaps the same effects would be present in Dr. Reynolds' castings and that, if he had used closed tops, the amount and distribution of porosity would have been different.

DR. REYNOLDS agreed that Mr. Hughes' point was an important one but regretted that he, personally, had little evidence to put forward. Undoubtedly, the effect of using sand covers could be considered a less extreme case of using exothermic or insulating covers and sleeves. Mr. Gray, of the English Steel Corporation, Sheffield, had made a detailed study of these conditions—even to the extent of chilling the feeder-head—and had demonstrated some remarkable effects on crystal structure and soundness. Mr. Gray and the speaker might disagree about the operating mechanism but there was no doubt about the importance of the results.

Application of Tests

MR. D. H. ARMITAGE said there were several points on the Paper by Mr. Middleton and Dr. White which interested him. It had been divided into three sections, and as a result each section contained an item of fundamental importance and application to foundrymen. In the section regarding tests on bentonite, he would like to know whether the Authors considered the "life" test, which was a quite important potential tool to foundrymen was past the stage of testing and was worth writing up as a standard method of proving the life of clays.

In the second section, dealing with resin-bonded cores, he had been interested to learn of the results on the use of resin-bonded cores with particular reference to di-electric drying. He understood that it now rested with the suppliers of production-type di-electric equipment to provide plant as good as that which was available in the laboratory.

In the last section, Mr. Middleton made a point of the fact that room-temperature tests did not give any guide to the resistance of a given mould material and suggested that work was now proceeding on testing at high temperatures. He would be interested to know the testing temperature visualized by the Authors, because it appeared from the charts shown that hot-tearing was occurring near the casting temperature of the steel, and, therefore, presumably any method of testing to be worthwhile would have to be done at this temperature—a procedure which would bring many practical difficulties. Instead of following that line, might it not be possible to conduct further work and standardize the test which Mr. Middleton had devised as a hot-tear test-piece for moulding materials?

MR. MIDDLETON pointed out that the "life" test described in the Paper was purely a laboratory test and that the results it had given with the different clays were still to be proved in practice. Foundry trials were now in hand, and it depended on the results of these whether or not the "life" test could be proposed as a standard method.

As far as di-electric baking was concerned, Mr. Armitage was correct in saying that the problem now rested with the suppliers of the di-electric heaters. Provided the electrical characteristics of the di-electric apparatus were suitable, it was possible to bake resin-bonded cores as efficiently by this means as by the more conventional methods.

With regard to the effect that the room-temperature properties of the sand had upon the incidence of hot-tearing, it had been established that for a *given* sand mix these were important, the higher the density of the sand and hence its compressive strength, the greater was the resistance offered to contraction and the more likelihood there was of tearing. When comparing different sand mixes, however, the room-temperature properties appeared to have little effect on the resistance offered to the contraction of the casting. Any high-temperature tests that are contemplated on sands would certainly have to include temperatures as high as 1,450 deg. C., for it had been found that the sand in the close vicinity of quite small castings was raised to such temperatures soon after pouring.

Similarity to Non-ferrous Work

MR. R. W. RUDDLE said he had been most interested in the Paper because a large amount of work had been done on similar subjects with non-ferrous alloys in the last decade or so; in particular a substantial contribution had been made by his colleagues at the British Non-Ferrous Metals Research

Association. He considered that the observations of Reynolds and Preece were very closely paralleled by similar observations made on non-ferrous alloys. For example, as in steel, a region of columnar structure in a non-ferrous alloy casting was generally sound and specimens cut from these regions generally had a higher strength than the micro porous equiaxial regions. The appearance of broken test-pieces from columnar and equiaxial regions of non-ferrous alloy castings was very much the same as was shown in Fig. 7 of the Paper.

A point of some interest arose in this connection. It was found with certain non-ferrous alloys that the incidence of microporosity did not necessarily cause any marked diminution in the strength of the material, provided the cavities were distributed at random. However, it sometimes happened with certain alloys that these holes appeared in layers and in this event a large fall in strength was found. He enquired whether the Authors had observed this layer type of porosity in any of their steel castings.

Not only were phenomena observed in non-ferrous castings akin to those reported by the Authors but closely similar explanations had been advanced for them, as the Authors would doubtless agree if they compared their explanations with some of the papers on non-ferrous alloys published during the last few years.

He had been specially interested in the Author's observations on convection currents during freezing of wax models and their suggestion that similar convection was present during the freezing of steel castings. Some years ago, he had carried out some experiments on a rather curious alloy consisting of aluminium containing about 30 per cent. of copper, in which he had noticed that there was a period shortly after the beginning of freezing during which temperature gradients were virtually absent for some minutes. The test casting was a cylinder 5-in. dia. and 10-in. long. It was, of course, difficult to account for the transfer of heat during this period in which temperature gradients were absent and he had very tentatively suggested that heat-transfer was occurring as the result of convection in the mixture of liquid metal and solid crystallites. The experiments carried out by the Authors seemed to lend some support to this view.

He enquired what the carbon content was of the steel used in the majority of the work. Dr. Reynolds had mentioned a figure of 0.25 per cent. at the beginning of the Paper, but he was not sure whether that applied to the rest of the experiments. He asked this question because Pellini in the United States had shown that the carbon content of steel greatly affected its mode of freezing, a high carbon content producing a greater tendency towards equiaxial structures.

It had been found that a certain amount of feeding in non-ferrous castings took place by what was termed "mass feeding," which consisted of a kind of settling process which tended to consolidate the plastic mass of liquid and solid metal, and he enquired whether the Authors had observed any such process in their steel castings. He added that if "mass feeding" were incomplete, it was liable to give rise to the layer porosity to which he had referred earlier.

(This concluded the discussion on this Paper at the meeting.)

WRITTEN COMMENT

THE AUTHORS thanked Mr. Ruddle for his interesting contribution which raised several important points and replied in writing as follows:—

First, no "layer" porosity—of the type found by Mr. Ruddle in certain non-ferrous alloys—was ever observed in their experimental castings; that is, if one excluded the band of semi-microporosity frequently observed at a columnar/equiaxial or columnar/nuclear interface. The fine porosity responsible for poor ductility was usually found to be filamentary, or interdendritic in nature, whereas any porosity occurring in the columnar zones existed as randomly distributed pinholes. In turn, they asked Mr. Ruddle if the layer porosity had ever been correlated with macrostructural features, as they thought it might be associated with the fine banding of alternate columnar and equiaxial zones examined by Northcott in steel and reported by the Authors as occurring in stearin wax models.

The Authors could reassure Mr. Ruddle on a further point by explaining that the carbon contents of the experimental castings varied only between 0.24 and 0.27 per cent., the great majority of the castings being at the lower limit. There was much evidence to show that "mass feeding" did occur in steel castings. This had been held by the Authors to be a root cause of microporosity, because it must seriously influence the directional nature of solidification.

Finally, the Authors stress Mr. Ruddle's point concerning the similarities between the freezing of ferrous and non-ferrous alloys. It was true that there were many differences of detail but it was their view that cognizance of those underlying principles held in common could be very informative. For this reason, they had been concerned to relate defects occurring in steel castings to similar happenings in non-ferrous metals and had introduced into the Paper the subject of simulation techniques. These methods were widely used in aeronautical and nautical research and from some of the results already achieved they felt this to be a most promising line for future investigations.

Bentonite "Life"

MR. A. F. TOSH, director Summersons' Foundries, Limited, wrote that he was much impressed by the mass of academic information and to a lesser extent by that of a practical type recorded by Middleton and White on the properties of bonding clays in part II of the Paper. During wartime, and to a lower degree since, British steelfounders relied mainly on home supplies and processing of bonding clays and it was a matter of personal regret, from a patriotic point of view, that this situation on the finding of these Authors was likely to change in favour of the American clay, even though

Research on Steel Castings—Discussion

mixtures exceeding 50 per cent. of the home-processed article were quoted as giving very good results. In support of the contention that there was more in the behaviour of a clay under actual foundry conditions than could be revealed by academic test or simulated "life" tests, recent experiences of Summersons' Foundries are recorded, in using Quest bentonite which is of Mediterranean (non-dollar) origin, but processed in this country:—

An extended trial of the home-processed bentonite from one supplier was made in the writer's foundry on the strict undertaking that the full requirements could be met and there would be no deterioration in quality. All moulds were cast in green-sand in the firm's mechanized foundry, where a sand-reclamation plant was in use. When using Wyoming bentonite, the mixture was:—

Reclaimed sand	80 per cent.
New clay-bonded sand ..	10 per cent.
New silica sand	10 per cent.

Each mixture was of 1,800 lb. and to each batch was added 12 lb. of bentonite, giving a green-compression strength of 7.5 to 8.5 lb. per sq. in. This mixture was continued with, but Quest was substituted for Wyoming bentonite, taking samples from each milling—this was in January, 1950. No immediate fall of green-strength was expected, owing to the amount of Wyoming bentonite already in the reclaimed sand but even after 3 months the green-strength figures remained the same, *viz.* 7.5 to 8.5 lb. per sq. in. The test was continued for a further 3 months and at the end of the total period no deterioration of sand properties was found. Since that time, supplies have been continuous and uniform and the quality of the foundry sand well maintained.

Similar results to the above might, perhaps, be found with other British-processed clays, but the writer has no personal experience of these. Bentonites from other sources, *e.g.*, North Africa, Argentine, New Zealand and India were also tried, however, but none proved as good. It is suggested that, in all fairness, the "life-testing" procedure for bonding clays should be overhauled to take cognizance of actual practical experience reported.

The Authors replied to Mr. Tosh, saying he appeared to have misinterpreted the conclusions arrived at on the basis of the laboratory "life" test. The latter showed clearly (for example, Fig. 15 of the Paper) that the bentonites of Italian and Greek origin had at least as good "life" as indicated by the retained green-strength as had Wyoming bentonite. The same view was also expressed on the basis of this test by Davison and White (*Proc.* IBF, 1953, **46**, A79). It would, therefore, appear that there was no conflict between the results of the Authors' test and Mr. Tosh's practical experience. There was, of course, no doubt that the ultimate demonstration of the usefulness of any clay was that provided by actual foundry use, but Mr. Tosh would agree that there was a real need for a laboratory test for assessing "life." This was the only reason why the Authors had attempted to devise such a test.

Resins and Oils Compared

MR. D. CHALDER (Leicester, Lovell & Company, Limited), submitted the following comment and questions:—

(1) Under the heading "Moisture Resistance of Di-electrically-baked Cores," section II, in Table IV, it is noticed that baking times are given as 2 hr. at 200 deg. C. for p.-f. and 2 hr. at 170 deg. C. for u.-f. mixes. This seems rather long for both types of resin, especially as the same time is given for the linseed-oil mix. Using a p.-f. resin of high solids and low water-content, one would expect the maximum baked strength to be reached in 15 min. at a temperature of 230 deg. C.; when used in a normal starch/resin mix, with 2½-3 per cent. water present, 25 to 30 min. should give the maximum strength, at the same oven temperature. Using an oven temperature of 200 deg. C., these times would be of the order of 25 min. for the resin (only) mix and 45 min. for the resin/starch mix. The resin-bonded-sand test-cores would be considered to be over-baked, by the writer's standards: the oil cores baked under the conditions given in the Paper would give approximate maximum baked strengths while the strengths of the synthetic-resin-bonded cores would be appreciably lower than the possible maximum. Assuming the foregoing to be true, the final results may not vary significantly, but the differences between the various bonds may be of a smaller order.

(2) A most important point is how much actual strength was retained after storage of cores over water, as distinct from the percentage retention of strength? This figure can be readily calculated for correctly-baked cores but not for under- and over-baked cores. Can the Authors please supply these figures?

(3) What quantity of water was absorbed by the cores? Would this quantity have any deleterious effect on general castings, apart from the obvious disadvantage of weakened cores?

Supplementary Data

In reply to Mr. Chalder, the Authors wrote that it was agreed that resin-bonded cores dried much faster than those which were oil-bonded, but it had also been found that, at least, in the case of the resins reported, there was little fall-off in strength as the baking time was increased to 2 hours at the temperatures which were shown as giving correct baking. The 2 hours baking time was, therefore, selected to ensure that complete drying out of the test-pieces would have taken place.

Whilst the Authors agreed with Mr. Chalder's reasoning, they did not think that decreasing the baking time would have had any appreciable effect on their main conclusion, which was that resin/starch-bonded mixtures if correctly baked either di-electrically or by stoving were at least as resistant to moisture as oil/starch-bonded mixtures.

With regard to Mr. Chalder's second point, the

(Continued on page 580, column two)

BCIRA Annual General Meeting

Successful Year's Work Surveyed

The annual general meeting of the British Cast Iron Research Association was held at Charing Cross Hotel, London, on November 2, the president (Mr. S. H. Russell) in the chair.

THE PRESIDENT, presenting the 34th annual report of the Council*, for the year 1954-55, said the most interesting feature of it was the diagram which showed the increase of the Association's income over the years, a very gratifying increase; he hoped it was appreciated that in the few months during which the Association had been quite sure that the additional money was available it had made every effort to use that money in a really worthwhile manner. It had been reported that morning that the chairman of the Research Board was quite satisfied that every effort was being made to build up the staff to its new strength.

Accounts

The statement of accounts had been included in the official notice of the meeting; the Association had accumulated, in the year ended June 30, quite a substantial surplus; but much of that was earmarked for capital development, and by the time the present 5-year period had elapsed it would probably find that it had absorbed not only the income, but the whole of the accumulated surplus, and would be forced to acquire fresh funds.

There was a minor alteration in the form of the Balance Sheet, and the president invited the hon. treasurer to deal with it.

MR. EVERARD P. MAJOR (hon. treasurer) said the Balance Sheet and the income and expenditure account showed that there had been a transfer of £75,000 from the year's excess income to the building and equipment fund, a new wording on which the auditors, in consultation with the officers, had agreed. The first item of £75,000, shown under this heading, was the balance balance brought forward from what was previously termed "capital reserve," to this was added the £75,000 referred to above, transferred from excess income, making a total of £150,000 in the building and equipment fund. The general fund at June 30, 1955, amounted to £69,696, so that the total accumulated funds came to £219,696, to be used for furthering the general work of the Association for this quinquennial period. The £150,000 under the sub-heading "buildings and equipment" was intended to cover capital costs, and the amount under "general" would meet any revenue deficits in the years to come.

On the motion of the chairman, seconded by Sir Frederick Scopes, the report and accounts were approved and adopted.

Election of Officers

President.

MR. N. P. NEWMAN, proposing the re-election of Mr. S. H. Russell as president of the Association in accordance with Article 24, paid tribute to Mr. Russell's excellent work in the interests of the industry generally and for the BCIRA in particular. All were very grateful to him, and the Association could do no better than to ask him to serve again.

MR. COLIN GRESTY, seconding the motion, endorsed Mr. Newman's remarks.

MR. RUSSELL, who was unanimously re-elected, said he was extremely grateful for the honour of being president for a second year; he rather enjoyed the work. It was very encouraging that the Association was over the financial "hurdle"; the problem now was to use the funds to the best advantage, and he could be relied upon to do his very best to see that that was done.

Vice-presidents.

On the motion of Mr. G. H. Johnson, seconded by Mr. W. J. Colton, the following were re-elected vice-presidents in accordance with article 24:—Mr. C. C. Booth; Mr. S. W. Martin; Mr. A. E. Pearce; Mr. J. J. Sheehan, and Sir Harold West. The president of the Institute of British Foundrymen, Dr. A. B. Everest, was elected a member of Council and a vice-president.

DR. EVEREST, in thanking the Association for his election, said the Institute very much appreciated the gesture and looked forward to further co-operation between the two bodies.

MR. H. J. V. WILLIAMS proposed that the warmest thanks of the Association be accorded Mr. J. Bell, who retired from the office of vice-president. Although, he said, Mr. Bell was not able to attend all the Council meetings, in view of the geographical situation the fact that he had attended as often as he had was an indication of his great interest in the Association. The vote of thanks was seconded by Mr. W. Barnes, and warmly accorded.

Council.

On the motion of Mr. R. L. Handley, seconded by Mr. A. E. Pearce, it was resolved that the re-election of members of Council retiring automatically under Article 29 be dealt with by a single resolution Mr. Handley proposed and Mr. Pearce seconded that the following, retiring automatically under Article 29, and eligible for re-election, be re-elected:—Mr. D. K. Barclay; Mr. T. M. Herbert; Mr. R. S. M. Jeffrey; Mr. A. E. Peace; Dr. L. B. Pfeil; Mr. R. C. Shepherd; Mr. J. F. Stanier, and Mr. L. F. Wright, and that the following members of Council, appointed during the year ended June 30, 1955, in accordance with Article 31, be re-elected:—Mr. W. Barnes; Mr. G. R. Buckley; Mr. E. Freer, Mr. H. G. Hall; Mr. G. S. Steven, and Mr. H. J. V. Williams.

(The motion was carried.)

On the proposition of MR. H. FIELD, seconded by MR. G. R. SHOTTON, the meeting also elected the following as members of Council under Article

* Abstracted in last week's JOURNAL.

BCIRA Annual General Meeting

25:—Mr. E. S. Renshaw, and Mr. R. Taylor. In making the proposition, Mr. Field said the services of Mr. Renshaw, of the Ford Motor Company, Limited, were well known, as were also those of Mr. R. Taylor, of Robt. Taylor (Ironfounders), Limited, who had become chairman of the Scottish Committee on Mr. J. Arnott's retirement. Mr. Shotton also paid tribute to the work of both those gentlemen and said it was particularly gratifying that the Ford Motor Company was taking an interest in the work of the Association.

SIR FREDERICK SCOPES voiced the thanks of the Council to Mr. Arnott for his services, which the meeting applauded.

Appreciation

Council and Committees.

MR. F. ARNOLD WILSON, proposing that the warmest thanks be accorded the Council, committees and sub-committees for their work during the year, commented that, judging by the annual report, they had all been extremely active.

MR. R. DARBY supported the proposition and took the opportunity to say how glad were some of those concerned with the commercial side to hear the proposals with regard to phosphorus in pig-iron. Only slightly over 5,000 tons of hematite ore was charged per week in Great Britain, whereas something like 170,000 tons of imported low-phosphorus ores were charged each week; so that it was realized how very apposite was the work guided by the director of the Association.

(The vote of thanks was heartily accorded.)

Chairman.

MR. KENNETH MARSHALL, proposing the thanks of the meeting to Mr. Russell for having presided, said it was always a pleasure to sit in his genial presence, and that this meeting had proved no exception. He coupled with the proposal an expression of warmest thanks to Mr. Russell for the interest he took in the Association's affairs and the work he did on its behalf, and voiced the expectation of favours to come. The proposal was seconded by Mr. A. E. Pearce and was carried with acclamation.

THE PRESIDENT, responding, said he wished that all the meetings for which he was responsible proceeded as happily as had that one.

Director and Staff.

THE PRESIDENT expressed on behalf of the Council very deep gratitude to the director and staff for the unselfish work they were doing. Quite candidly, he said, when it had been his lot to review salaries he had felt that the Association was getting extremely good value for money. They were a very loyal team and he had worked with them very happily in various capacities. The staff was now of some considerable size, and he asked the director to convey to them the Council's gratitude for the services rendered during the year.

MR. H. G. HALL, seconding, said that he, too, had some opportunity for intimate contact with the Association's staff; so that he could endorse that they were a very happy and loyal team and were doing magnificent work.

(The vote of thanks was warmly accorded.)

DR. PEARCE returned thanks on behalf of himself and his staff for the compliments paid, and assured the meeting that they would do their utmost to deserve them in the coming year.

Metal and Mould Research on Steel Castings

(*Continued from page 578*)

figures he required were unfortunately omitted owing to the need for brevity; they were now shown in Table V.

TABLE V.—*Strength of Cores retained after Storage over Water for Underbaked and Overbaked Cores.*

UNDERBAKED

	Oven.			Di-electric.		
	Temp., deg. C.	Time, min.	Strength lb. per sq. in.	kw	Time, min.	Strength lb. per sq. in.
(*a*) U.-f. resin 2 per cent. resin ..	170	15	163	0.6	6	170
1 per cent. resin .. 1 per cent. starch ..	170	15	186	0.6	2½	208
(*b*) P.f. resin 3 per cent. resin ..	200	15	177	0.6	5	176
1 per cent. resin .. 1 per cent. starch ..	200	15	230	0.6	4	221

OVERBAKED

	Oven.			Di-electric.		
	Temp. deg. C.	Time, hours.	Strength lb. per sq. in.	kw	Time, min.	Strength lb. per sq. in.
(*c*) U.-f. resin 2 per cent. resin ..	200	2	170	1.0	8	168
1 per cent. resin .. 1 per cent. starch ..	200	1	190	1.0	6	227
(*d*) P.-f. resin 3 per cent. resin ..	225	2	98	1.0	10	148
1.5 per cent. resin .. 1.5 per cent. starch ..	220	2	210	1.0	8	255

In reply to Mr. Chalder's third point, the Authors had not in all cases determined the moisture pick-up of the cores. The data obtained, however, was consistent with the deteriorations in strength observed, *e.g.*, resins alone when correctly baked absorbed less moisture than resin/starch mixtures or incorrectly-baked resins. With the former, moisture pick-up of the order of 0.2 per cent. of the test-piece weight had been observed after 20 hours over water. With the latter, the moisture pick-up in the same time varied between 0.3 and 0.6 per cent. of the test-piece weight. Moisture present in the latter amount could contribute appreciably to gas evolution, but the major problem appeared to be loss of mechanical strength.

IBF Lancashire Jubilee

First Fifty Years of Branch Activity celebrated in Manchester

The golden jubilee of the formation of the Lancashire branch of the Institute of British Foundrymen (the first branch to be formed) was celebrated in Manchester during the week ending November 5. The first function was a Press conference (referred to briefly last week), at which the aims and work of the Institute, the history of the branch and the attention given to education were among topics explained by the branch president, Mr. A. Kirkham. Booklets were also distributed showing opportunities for youth in foundries—the whole with the intention of proving to the lay public (through the medium of the Press) how far the foundry industry has progressed from the days when the sobriquet "Cinderella of Industry" was applied.

Other branch jubilee celebrations included a dinner and smoking concert attended by some 80 or more members, old members and guests, held at the Midland Hotel, Manchester, on Friday, November 4. The president of the Institute, Dr. A. B. Everest, the senior and junior vice-presidents, Mr. H. J. V. Williams and Mr. J. Blakiston, and the national secretary, Mr. G. Lambert, were at the high table, with Mr. Kirkham presiding.

HISTORY OF THE BRANCH

Foundrymen in the Lancashire area were prominent in the original group of Institute members. The first conference was held in Manchester in 1904, and their interest warranted the calling of a meeting in the Manchester YMCA in November, 1905, to consider forming a Lancashire branch. At this meeting, attended by Mr. F. W. Finch, honorary secretary of the then British Foundrymen's Association, Mr. J. G. Stewart was elected chairman. After some discussion, inspired by the enthusiasm of Mr. Finch and assisted by his guidance, the decision to form the Lancashire group within the Institute was taken.

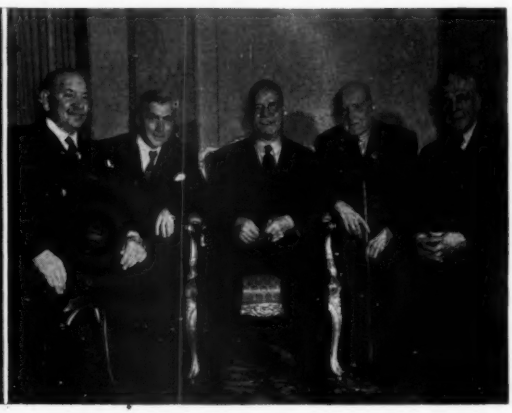
Its first title was the "Lancashire District" and the officers elected were:—As president: Mr. W. Russell, jnr. (Pendleton); vice-president, Mr. W. H. Sherburn (Warrington); hon. secretary: Mr. J. G. Stewart (British Westinghouse Company, Limited); and committee: Mr. R. W. Kenyon (Accrington); Mr. Carson (Manchester); Mr. Butler (Pendleton); Mr. Markland (Bolton); and Mr. Howarth (Broadheath). Meetings were to be held the first Saturday of the winter months at the municipal School of Technology, Manchester; the original members came from Lancashire, Cheshire and Yorkshire, mostly from the Halifax area—a well-known member being Mr. Jack Robinson of that town—and from North Wales.

Little is known of the struggles of the group over the next few months, but they persevered; in 1906 Mr. W. H. Sherburn became president; in 1907 the first printed syllabus was circulated, the first regularly recorded activities of the group were kept, and the title was altered to "Lancashire branch." These records are interesting for not only do they show the interest these founder members had in their industry, but also that they were concerned with the betterment of mankind generally.

The branch continued with varying degrees of success, the work of Mr. R. W. Kenyon was signalled by his election as vice-president of the Asso-

Present-day officials of the Institute of British Foundrymen (left) and "old-timers" of the Lancashire branch (right), at the golden jubilee celebrations of the branch in Manchester recently.

From left to right: Mr. F. W. Nield, Mr. H. J. V. Williams, Dr. A. B. Everest, Mr. A. Kirkham, Mr. J. Blakiston, Mr. G. Lambert, Mr. Barron, Mr. W. Rawlinson, Mr. A. Key, Mr. W. H. Meadowcroft, and Mr. J. Hogg.



Mr. J. Hogg, for many years secretary of the Lancashire branch, presenting the first and second volumes of the branch minutes to Mr. A. Kirkham, this year's branch president, during the jubilee celebrations.

ciation in 1910, but always the basis of the branch was the support of its members among whom the names of Mr. J. H. Reynolds, Mr. J. Simkiss, Mr. E. L. Rhead, Mr. G. Buchanan, Mr. J. Penlington, Mr. O. Stubbs, and Mr. H. Sherburn, jnr., might be added to several already listed.

Early Enthusiasm

The enthusiasm of the original members is shown not only by their attendances and support but also by the number of times they presented papers. In 1910, papers by Mr. F. Andrew of Oldham and Mr. S. G. Smith of Chesterfield appeared for the first time; both were well known in later years. The social side of the branch activities was not forgotten; in 1908, the branch had made sufficient progress to warrant holding the first annual dinner for men only, no records of this event appears to exist,* but they do so of the second dinner, held on October 23, 1909, at Victoria Hotel, Manchester —and a good time members had, at 3s. per head! The end of 1914 brought with it the commencement of the new classes in ironfounding organized by Mr. E. L. Rhead, at the School of Technology, Manchester, and although the start saw only three pupils, as the years went by, many foundrymen passed through those classes, the origin of to-day's foundry education activities.

From then until the early 1920's, the branch made up for past difficulties and went from strength to strength, with efficient officers, larger membership and increased attendances; to this record may be added the remarkable improvement of branch affairs due to the valuable work of Mr. J. Hogg as hon. secretary. The application for Royal Charter by the Institute which was successful in 1921, brought fresh demands upon the energies of the officers and pressing needs for finance. These were well met by the branch, ably led by Mr. O. Stubbs, who was elected national president in 1921-22. The establishment of the Burnley section in 1921 was indicative of the growth of the branch and widened its scope in this area.

Good Secretarial Work

After a long and successful period in office as hon. secretary, Mr. J. Hogg retired in 1921; he was succeeded by Mr. Tom Makemson. Another milestone in the history of the branch was marked by the fact that in 1922 it became the largest in what was by then called the Institute of British Foundrymen. A new field of activity was opened by the creation in 1925-26 of the junior section, with Mr. A. Hodgkinson, Salford, as its first president, and in 1926 Mr. John Thewlis Johnson, of Manchester, presented a medal to be known as the "John Wilkinson Memorial Medal" for competitions amongst its members, the first winner being Mr. R. Yeoman.

During this year, the capabilities of the Lancashire branch secretary, Mr. Tom Makemson, were recognized by his election to office as general secretary of the Institute, and his recent untimely death has brought to the notice of all members—old and new—his high qualities and devotion to his duties in this office. In Mr. Harry Stead, the Lancashire branch were again fortunate to have another member who took over the duties of honorary secretary with honest zest. With the great help of Mr. W. Est, the Preston section was formed and ran successfully for many years, extending the services of the branch in that area. The late 1930's found the same expansion, making the branch still supreme in membership and a thriving organization. Tribute here must be paid to the ladies of the Lancashire branch who were then admitted to the annual dinners, for when Lancashire branch members presented to the Institute the presidential gold badge of office to be worn on official occasions, the ladies followed suit and presented to the president's lady a gold badge, and many were the functions organized by them to raise the necessary finance.

Members of the Lancashire branch were active and prominent in every phase of the Institute's national organizations, and honours bestowed upon them are recorded in the branch handbook. For instance, the establishment of the "Oliver Stubbs Medal" to perpetuate the work Mr. Stubbs did within the Institute and its endowment by the National Ironfoundry Employers' Federation—in token of the work he also did in that organization —is outstanding. The first diploma was awarded to a Lancashire branch member, Mr. J. Hogg, on whom was also bestowed honorary membership of the Institute for his work on behalf of the Lancashire branch and the Institute in general, including 21 years' service on the general council. Four of the past-presidents of the branch were original members of the old British Foundrymen's Association, and still attending meetings is Mr. W. H. Meadowcroft, past-president of the branch

* A brief account of this event did however appear in the November 1908, issue of this JOURNAL. It was held at the Victoria Hotel on October 3—EDITOR.

and one of the original members, full of the humour of his native heath and a philosopher by nature. Presidents of the Institute have come from the Lancashire branch on five occasions—Mr. J. Little, Mr. O. Stubbs (twice), Mr. R. W. Stubbs, and Mr. E. Longden. Mr. W. Jolley was the first chairman of the Institute's Technical Committee and Mr. Longden and Mr. A. Phillips have both rendered excellent service in these activities.

DINNER

The assembly at the Midland Hotel, Manchester, for the dinner and smoking concert on November 4 included at the high table a number of members with records of long service to the branch. These were specially referred to by the CHAIRMAN (Mr. Kirkham) when, after the loyal toast, he proposed a dual toast; namely, "Our Guests." On his one hand were the senior officials of the Institute (already mentioned by name) and on the other hand members of the Lancashire branch who joined the Institute prior to 1912. He referred particularly to Mr. Key, who was branch president in 1917; Mr. W. H. Meadowcroft (president in 1920); Mr. W. Rawlinson, who had been an active member since 1912; and Mr. J. H. Hogg, branch president in 1936.

Speaking of the progress of the Institute, Mr. Kirkham said the work of the technologist and the craftsman was full of interest and he who could be interested in, and enthusiastic about his job, had gone a long way towards living a full and happy life. "It is significant that, when foundrymen started this new national organization, they thought not about wages, conditions or employment; or the relationship to trading conditions, but of progress in foundry technology, in improving foundry technique," he said.

President's Experiences

DR. A. B. EVEREST, replying to the toast, said that early last year there had been celebrated the golden jubilee of the Institute and now, 18 months afterwards, in Manchester, members were celebrating the fiftieth anniversary of the formation of the first branch of the Institute and he congratulated the branch on being the first to reach this age. The Lancashire branch had a very high place in respect of all members of the Institute and the history showed a very wonderful record.

He remembered the first time he lectured to the branch. Then, he was a not-so-young member of the Institute, talking about alloys and cast iron. His horror could be imagined when he went to the lecture room to find that someone beforehand had stacked the table high with castings. Most of these showed faults such as misrunning or something like that and he was expected to speak from behind the pile of castings. He recalled how after the lecture some member of the branch had said "Yes, this is all very well, but we want the lecturer to tell us how to make these castings good."

The president went on to say how very proud he was to speak in the first place on behalf of some of the older branch members, some of whom had been named. They would be the first to say that the branch which they helped to build up so well was to-day a thoroughgoing concern. He appealed to the present members of the branch from time to time to recall the efforts of the men who had worked so hard for the branch and helped to put it in a position which to-day was regarded even with some jealousy by some of the older metallurgical institutions in the country.

In closing, Dr. Everest referred to the work of the present hon. secretary, Mr. F. W. Nield, and also to the social secretary, Mr. W. S. Spenceley, who had been responsible for the success of the present function.

Reminiscences

MR. J. H. HOGG, who next addressed the assembly, said he had been thinking of what some of the early members of the branch, if they could have been there, would have thought of the golden jubilee banquet. They used to meet in the Manchester Technical College on Saturday afternoons and a number came from distant parts of Lancashire and some from Cheshire as well. As in those days they started at six o'clock in the morning and worked until half-past seven at night and often two hours overtime as well, it was impossible to hold evening meetings. Lectures were heard on all sorts of subjects but bad castings provided quite a common theme.

Foundrymen might have looked upon themselves as cinderellas of the engineering industry in the past, he said, but he had always found that people of high degree never objected to coming along to meet foundrymen. When one considered it, what greater skill was there than by giving a man a few strickle boards and a sketch to turn out a casting of fine precision?

Mr. Hogg, at this juncture, thanked members for electing him an honorary member of the Institute. It was an honour which he valued very greatly. Concluding his remarks, he referred to books he had been given for safe keeping—the first and second minute books of the branch—and said now the time had arrived for him to hand them over.

(Here, he presented the two volumes to Mr. Kirkham, who later handed them to Mr. Lambert for storing with the Institute's archives.)

Another speaker, MR. RAWLINGS, said he believed the present time offered a challenge not only to young founders, but to the profession generally. There was opportunity for them to make a contribution to the great engineering industry of the country. He said this "with his tongue in his cheek," for due to the shortage of labour to-day there seemed to be many castings which were not up to his standard.

MR. KIRKHAM, closing the function, paid a warm tribute to Mr. Yeoman for the research work which he had done in the compiling of the history of the branch and reiterated his thanks to all the organizers of the jubilee functions.

News in Brief

STOKE CASTINGS, LIMITED, is having extensions erected to the machine shop at Union Foundry, Mansfield, Notts.

THE SHEFFIELD OFFICE of Honeywell-Brown, Limited, has moved from Oak Dale Road to larger premises at 119, Petre Street, Sheffield, 4.

ERNEST FAIRBAIRN, LIMITED, announce that as from November 21, their address will be Manfield House, 376/9, Strand, London, W.C.2.

EDWARDS (BRIGHOUSE), LIMITED, has had plans approved for the erection of a brass and aluminium foundry at Elland Road, Brighouse, Yorkshire.

HEAD, WRIGHTSON & COMPANY, LIMITED, plans to extend the steel foundry at Teesdale Ironworks and build a canteen in Nile Street, Thornaby-on-Tees.

IN ORDER to make appeal to a wider circle of engineers, the title of the Diesel Engine Users Association has been changed to the Diesel Engineers and Users Association.

A BOILER CONTRACT received by Babcock & Wilcox, Limited, Renfrew, for a steam station which the New Zealand Government are to build on the Waikato coalfield, is valued at nearly £2,000,000.

THE INDUSTRIAL WELFARE SOCIETY, Robert Hyde House, 48, Bryanston Square, London, W.1, announces that it has produced nine new case studies on filmstrips with accompanying gramophone records.

ON THE OCCASION of the last meeting of the Non-Ferrous Club, a round-the-table collection yielded £16 10s., which is to be donated to the Earl Haig Fund. A dinner/dance is to be held at Chadwick Manor Hotel on December 1.

ICI IS TO BUILD, near its existing works at Waunarlwydd (Swansea), a factory for the fabrication of titanium. Work will begin as soon as possible and it is hoped that the new factory, which will cost about £2 million and employ some 250 people, will be in production in 1958.

OFFICERS of the British Association, which is to hold its 1956 meeting at Sheffield, visited the city on November 5, and met the Lord Mayor, Alderman J. Curtis. They discussed preliminary arrangements for the meeting with Corporation officials and representatives of Sheffield University.

JOHN DALE, LIMITED, of New Southgate, London, N.11, and elsewhere, have issued a booklet to all their employees detailing a scheme whereby shares in the company, yielding 6 per cent. per annum, can be bought by all workpeople who have been employed for a minimum of one year.

THE ENGINEERING DIVISION of Lotus, Limited, Sandon Road, Stafford, makers of machinery for the boot and shoe trade, have taken over F. Bowen & Sons, Foregate Aluminium Foundry, Stafford, to ensure good deliveries. The foundry will, however, continue to work for other consumers.

A "RAYBURN WEEK" at the Berkley Street, Birmingham, showrooms of Rowe Bros. & Company, Limited, included a special evening demonstration of new Allied Ironfounders' appliances, and showings of the films the "Stockton Test," "There's a Job to be Done" and "Hip, Hip Hoo-Rayburn."

SIR STUART GOODWIN, the Sheffield industrialist, and Lady Goodwin, have each given £250 to the Sheffield Boy Scouts' movement. It was stipulated that the money should be spent on the boys themselves and the executive committee has decided to allocate £5 to each group in Sheffield for the purchase of camping and other equipment.

STEEL valued at £1,160,000 has been ordered from the United Steel Companies, Limited, Sheffield, by the Pacific Great Eastern Railway of British Columbia. The announcement of the order added that United Steel was acting on behalf of British makers. The contract is for 24,000 tons of rails and 4,000 tons of angle bars and tie plates.

TEES FOUNDRIES, LIMITED, announce that the name of the company has been changed, and all communications should in future be addressed to Pease & Partners Tees Foundries, Limited, at P.O. Box No. 83, Tees Iron Works, Middlesbrough. There has been no change in the management or constitution of the company, and the new Pease & Partners, Limited, owns all the share capital.

THE QUESTION of whether shortage of fuel and power will set limits to the expansion of industrial activity is an important one in relation to this country's future. Some aspects of this problem will be dealt with by Dr. G. H. Daniel, chief statistician at the Ministry of Fuel and Power, in London on December 15, when he presents a paper on the subject to the Institution of Production Engineers.

THE "ATOMS FOR BRITAIN" EXHIBITION, which created world-wide interest when originally staged at Geneva during the recent atom conference, will be seen for the first time in this country at next year's British Industries Fair. It is to be presented by the UK Atomic Energy Authority and will be a major feature in the BIF electrical and electronics section at Olympia, London, from April 23 to May 4.

WILKINS & MITCHELL, LIMITED, Darlaston, report that they have received an order from A. B. Bofors, Sweden, for three Forgemaster high-speed forging presses and an extrusion press. It was secured in the face of strong competition from other countries. The company has also recently received its first order from Spain for heavy-duty stripping and setting presses for one of the chief forges in the Spanish Peninsular.

SIR KENNETH HAGUE, deputy chairman and managing director of Babcock & Wilcox, Limited, who has just returned from a visit to Brazil, reports that the new factory which the company is to operate there will be at Rezende, between Rio de Janeiro and St. Paule. It will employ more than 200 people. Opening early next year, the factory will make part of the boiler plant which Brazilians insist should be produced in their own country.

ACCORDING to Mr. F. J. Erroll, M.P., Parliamentary Secretary to the Ministry of Supply, speaking at the annual dinner of the British Bronze and Brass Ingot Manufacturers' Association on November 5, the Association has performed a most valuable service to the country since its inception in 1946. He said that the 28 members produced about 80 per cent. of the 100,000 tons of unwrought copper alloys produced in this country.

OIL-FIRING FOR HEATING is to be introduced in new schools in Cheshire as an economy. This was announced at a meeting of Cheshire County Council at Chester on November 10, when Dame Lilian Bromley Davenport, chairman of Cheshire Education Committee, said that it was necessary because of the alarming rate of increase in prices of coke and coal. Coke, she said, was costing 30 per cent. more than last year, and coal 18 per cent.

THE ANNUAL DINNER of the Institution of Mechanical Engineers (East Midland branch) was held at the Victoria Station Hotel, Nottingham, on November 8. Among those present were:—Mr. P. L. Jones (president of the Institution); Mr. L. Worn (secretary); Mr. B. L. Hallward (vice-chancellor, University of Nottingham); Mr. J. H. R. Nixon (chairman); Mr. A. A. Rubbra (Rolls-Royce, Limited); and Mr. B. G. Robbins (secretary of the Institution).

SAFETY CODES for different aspects of industry and trade, which are being drawn up by the Sheffield branch of the Institute of Industrial Safety Officers, include the handling of corrosive liquids; work on or near overhead cranes; transport (road and rail) in works; repair of gas furnaces; and maintenance of buildings. The first completed safety code, dealing with the use of ladders, steps and trestles, has been sent to the Institute's general council in London for approval.

BRITISH THOMSON-HOUSTON COMPANY, LIMITED, Rugby, have received through their associated company, Australian Electrical Industries Pty., Limited, an order worth approximately £400,000 for the Broken Hill Proprietary Company, Limited, Australia. This covers the electrical driving equipment for an 18-in. continuous steel strip and skelp rolling mill to be installed at the Broken Hill Proprietary Company's Newcastle works, New South Wales.

IN THE OCTOBER ISSUE of *Gjuteriet* (the Swedish foundry journal), there is an interesting article by Mr. P. Fagerström and Mr. R. Orban on the use of colour in foundry accident prevention. Where there is a risk of accident, the component of a machine or a locale is marked in yellow; blue indicates control; green colouring denotes protective contrivances, whilst red is reserved for fire-extinguishing apparatus. The article is beautifully illustrated with coloured pictures.

LEICESTER, LOVELL & COMPANY, LIMITED, announce that from Monday, November 21, 1955, a "Telex" installation will be in operation at their Southampton address. This will bring more rapid contact with firms who are already "Telex" subscribers, and will greatly speed receipt and despatch of telegrams and cables. The latter items should continue to be addressed to "Stronglu," Southampton, whilst other "Telex" subscribers should note the firm's number—47-526.

BRITISH double-decker buses have been chosen to serve the rapidly expanding industrial and residential areas of the Cape Flats in South Africa. Golden Arrow Bus Services, Limited, has just placed five of these buses in service—they are Leyland "Titans" fitted with the latest type of 63-seater double-deck bodies built by Bus Bodies (S.A.), Limited. The company, which started its Cape service in 1928 with a Leyland single-decker, is now anticipating future requirements of this community by placing a further order for ten "Titans."

MR. AMBROSE FIRTH, chairman of the Brightside Foundry & Engineering Company, Limited, Sheffield, considers that the new wave of wage demands cannot be justified. He states that trade union leaders should do their utmost to educate the rank and file and tell them plainly that it cannot benefit them in the long run to have increased wages without increased productivity. He says that production per man/hour must be increased and any form of restriction discontinued in order to ensure the standard of life we all wish to enjoy.

RESEARCH ON RUST PREVENTION is going rapidly forward at the works of George Salter, Limited, in Spring Road, Smethwick. The company is now working to the Government's two latest specifications. A feature of the works is an electronically controlled dry chamber where export goods are packed in an humidity-exhausted atmosphere. About 140 tons of metal products are prepacked at the works every week, 75 per cent. of it for Government contracts. Products are being sent to the firm from all over the country for packing, as many manufacturing firms are finding that they can save thousands of pounds a year by preserving their exports from rust.

WALTER SOMERS, LIMITED, Halesowen, near Birmingham, on November 10, entertained to lunch some 80 to 90 members of the Staffordshire Iron and Steel Institute. Addressing his guests, Mr. Frank Somers, chairman of the company, said that it was difficult to adjust oneself to the pace of industrial advance. In 1910 the cost to the firm of fuel for the year was £5,000 and wages £13,000. In 1955, £147,000 had been paid for fuel and £393,000 in wages. "In running a business to-day you not only need to make stuff, you want an accountant to see if you are making it at a profit," Mr. Somers said. He recalled that three members of his family had been president of the Institute—his father, his brother William and himself.

DUE TO THE RECENT INSTALLATION of an automobile casting foundry, and the further expansion now in progress in a similar direction at Guest Keen & Nettlefolds (Cwmbran), Limited, resulting in the interests of the company having become closely identified with the motor industry, the Guest Keen & Nettlefolds, Limited, board considered that many advantages would be obtained by closer liaison with the management of Garringtons, Limited, who are the largest suppliers in the country of forgings to the motor and agricultural engineering industry. Accordingly Mr. R. P. Brookes, chairman and managing director of Garringtons, Limited, has been appointed managing director of Guest Keen & Nettlefolds (Cwmbran), Limited.

ACCORDING to the *Ulster Commentary*, Lord Chandos, formerly Mr. Oliver Lyttelton, who recently accepted the Northern Ireland Government's invitation to become chairman of the new Development Council, visited Larne within 48 hours of the announcement of his appointment. As chairman of the British Thomson-Houston Company, whose £8 million factory project is the largest new enterprise to be established in Ulster since the war, he attended the laying of the foundation stone of the new office block, the ceremony being performed by Lord Brookeborough, the Prime Minister. A blading factory is already in production and buildings for the heavy turbine section are in course of erection. When the whole factory is in full operation in 1964-65, the number of workers will be 3,200.

ON NOVEMBER 10, a scale car, the first of three being supplied for service in a blast-furnace plant at Aviles, Northern Spain, by Head, Wrightson & Company, Limited, was lifted from the company's wharf on the River Tees by a floating crane belonging to the Tees Conservancy Commission, which will carry it down river to the ship which is to take it to Spain. The length of the car as shipped is 42 ft.; height 16 ft. 3 in.; width 9 ft. 6 in., and weight 4 tons. The car is completely assembled except for certain minor parts which have been removed to prevent their being damaged. When in service on the blast-furnace plant, the scale car, which is driven by electric motors, carries the iron ore which is being fed into the blast furnace and weighs the quantities used. The twin hopper of the car has a capacity of 500 cub. ft. and the car can carry loads up to 25 tons in weight.

Personal

LANGLEY ALLOYS, LIMITED, announce that MR. PETER J. A. LUBBOCK has been appointed publicity officer.

J. W. JACKMAN & COMPANY, LIMITED, announce that Mr. E. EVANS, who has been their representative for the Lancashire and Yorkshire area for a number of years, has been appointed general manager.

Mr. AMBROSE FIRTH, chairman and joint managing director of the Brightside Foundry & Engineering Company, Limited, Sheffield, has been appointed a director of Thos. Black, Limited, colliery agents, Glossop Road, Sheffield.

MR. JOHN HARPER BEAN, who was chairman of Garringtons, Limited, Bromsgrove, for many years until his retirement in June of this year, has been presented by his former colleagues with a gold perpetual chronometer watch. Mr. Bean continues as chairman of Beans Industries, Limited, Midland Industries, Limited, and B.R.D., Limited.

Major-General R. E. URQUHART has joined the staff of the Davy and United Engineering Company, Limited, in an administrative capacity. General Urquhart has had a distinguished army career, and since 1952 has been Commander of the British troops in Austria, where he remained until the completion of the peace treaty with Austria, and the final evacuation of all Allied troops last month.

MR. ALAN FAULKNER TAYLOR, chief photographer for the English Steel Corporation, Limited, Sheffield, has gained a premier award for nature photography, the medal of the Royal Photographic Society. Mr. Taylor entered six prints for the society's 1955 exhibition, opened on November 7, by Lady Tweedsmuir at Princes Gate, London, and five are shown among the 200 selected from 500 entries. One is of a house cricket which he found in his office at the works.

HADFIELDS, LIMITED, have appointed Mr. J. HANSCOMB, B.A. (CANTAB), and Mr. G. E. GILL as their sales representatives in Scotland, succeeding Paul & Macleod, Limited. They have acquired the office accommodation previously occupied by Paul & Macleod at 82, Gordon Street, Glasgow, C.1, and from November 1 their Scottish sales representation will be conducted from that address. Mr. Hanscomb comes to Glasgow from Hadfields' sales staff in Sheffield, and since 1949 Mr. Gill has been with Paul & Macleod.

DURING a five-week 20,000-mile business trip to South Africa and the Rhodesias, Mr. S. C. TYRRELL, assistant managing director of Newton Chambers & Company, Limited, Thorncliffe Works, Chapeltown, Sheffield, kept nearly 100 business appointments. He is responsible for the excavator division at Thorncliffe and succeeded in opening new export markets for the NCK earth moving machines which are made at Thorncliffe in association with the Koehring Company of Milwaukee, USA. He met Mr. Charles J. Berry, managing director of Jeffrey-Galion (Pty.), Limited, the Johannesburg engineering company which is now acting as distributors for NCK machines in the three countries.

AFTER 40 years in the coke-oven industry, Mr. ALFRED B. EDMUNDS, general foreman in the coke-oven department at the Ebbw Vale plant of Richard Thomas & Baldwins, Limited, and Mr. ERNEST CLAY, shift foreman, have retired. Born in Caerleon in 1888, Mr. Edmunds began work as an apprentice bricklayer. Later he joined the staff of the Koppers Coke Ovens Company, Limited, Sheffield, to work on the building of 100 ovens at Llwynypia. In 1912, he went to Ebbw Vale to work on the building of a battery of 100 ovens and by-products plant, on the completion of which he joined the Ebbw Vale Steel, Iron & Coal Company as general foreman in the coke ovens departments.

THE DIRECTORS of Charles Roberts & Company, Limited, the wagon builders, of Horbury Junction, near Wakefield, recently held an informal luncheon party to celebrate the eightieth birthday of their chairman, Mr. DUNCAN BAILEY. The chairman started work at the age of 15 and has no intention of retiring yet. He is still a familiar figure about the works and he spends his leisure hours compiling his memoirs of a long career in wagon building. In 1890, Mr. Bailey became a junior in the works manager's department of the Birmingham Railway Carriage & Wagon Company, Limited. Some 10 years later he went as assistant general manager to Charles Roberts & Company. In 1916 he became a director of the company and took over the chairmanship in 1927. For many years he was also joint managing director, but relinquished the position in 1949.

Obituary

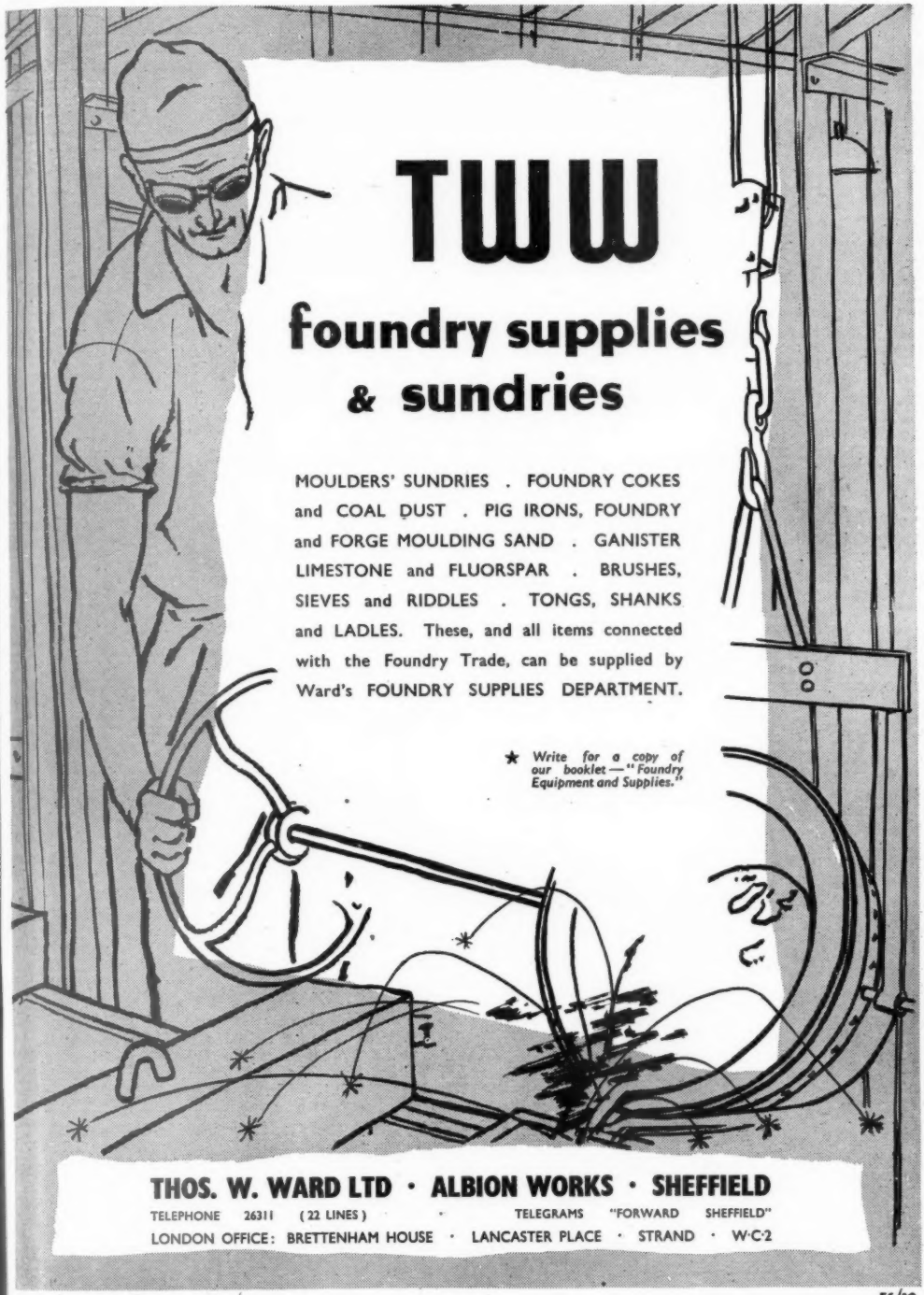
MR. ERIC INGRAM MAVOR, joint managing director of Mavor & Coulson, Limited, electrical engineers and coal-cutting machinery manufacturers, Glasgow, has died at his home at Newton Mearns, at the age of 61. He was the youngest son of Mr. Henry Mavor, founder of the firm.

Mr. ARNOLD SHORT, a founder member of the National Trades Technical Societies, died on November 11 at the age of 76. He was a member of the technical staff of the department of mechanical engineering of Sheffield University for 33 years and was at one time in charge of the department's production engineering workshops. He retired in 1944.

Mr. JOHN BARRINGTON PEARSON, who has died at the age of 73, was formerly chairman and managing director of Cowans, Sheldon & Company, Limited, crane and rail-plant manufacturers, of Carlisle. He joined the company as general manager in 1914 and in 1920 became managing director. Nine years later he was elected chairman. Mr. Pearson continued as managing director until 1946, and was chairman until 1953.

Mr. GEORGE FREDERICK TWEEDY, who has died at the age of 81, was a director of Swan, Hunter, & Wigham Richardson, Limited, ship builders and repairers, of Wallsend. He had spent most of his working life at the Neptune Engine Works, where he started as an apprentice in 1892. He subsequently became managing director of the works and a director of the company. In 1945 he retired from the management of the works and from the board of the Wallsend Slipway & Engineering Company, Limited, but remained on the Swan, Hunter board until the time of his death.

MR. J. B. WHITFIELD died at his home in Coventry on November 7, at the age of 70. Mr. Whitfield had been associated with Lake & Elliot, Limited, since 1908, in which year he was appointed its representative in the Midlands area. He was in charge of a branch office at Coventry until its destruction by bombing during the last war. For 18 years he was a director of the company, retiring from his executive appointment with the company in 1950, but remaining a member of the board. Mr. Whitfield was associated with the motor industry since its very early days, and throughout his life kept in personal touch with all developments as the industry progressed and expanded. His passing will be mourned by many of the surviving pioneers of the motor trade, by the personnel of Lake & Elliot, Limited, and by many of their customers and suppliers.



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FS/29

Raw Material Markets

Iron and Steel

The heaviest pressure now being exerted on producers for supplies of pig-iron comes from the steelworks and the general engineering and speciality foundries. The steelmakers are receiving impressive tonnages, which represent about 75 per cent. of total outputs, now running in the region of 249,000 tons a week of all grades of pig-iron. In addition to basic iron, a good percentage of the available supplies of hematite pig-iron also finds its way to the steelworks, but even so supplies are not enough and home deliveries have to be augmented by consignments from overseas.

While deliveries of scrap are fairly well maintained, overall supplies on hand and in prospect are not so plentiful, nor is the supply so assured as it was in the past, with the result that the steelworks will continue to rely mainly on the supply of pig-iron to enable them to obtain the ingot tonnage required to cope with their heavy commitments. Although record outputs of steel continue to be obtained and the year's target of 19,500,000 tons appears to be within reach, current demands for supplies of the different forms of steel far exceed the supply, and most of the steelworks are committed for their outputs for several months ahead. There is no sign of any diminution in their requirements of raw materials; in fact, these appear to be on an upward trend, and the additional tonnage of basic pig-iron which will be obtained from the new furnaces to be blown in later this year will be readily absorbed.

Of all users of pig-iron the engineering and speciality foundries appear to be the worst placed. The grades of their choice, the low-phosphorus and medium-phosphorus irons, are very scarce, total outputs being dwarfed by demands.

The large furnace now out of production of the low-phosphorus irons will provide a welcome addition to supplies when it again comes into blast, but this will not relieve fully the difficulties now being experienced by the foundries with demands at their present levels. Hematite makers cannot cope with all the demands made upon them, and in some instances orders are badly in arrears. Refined irons are also in much greater demand.

There is little change at the foundries which use high-phosphorus pig-iron. Many of the light foundries have capacity available for increased business and this applies also to the textile foundries. Most of the jobbing foundries are fairly busy. Outputs of high-phosphorus iron appear to have exceeded present demands, and some furnaces are offering increased tonnages to export merchants.

A good demand continues for heavy cast-iron and machinery scrap. Foundry coke is coming forward in sufficient quantities to meet current consumption requirements, and in some brands to augment stocks, but most of the Welsh grades continue to be scarce.

Non-ferrous Metals

The lack of any firm basis on which to view the outlook for copper continues to affect the London quotation. At the beginning of the week sellers were reluctant and the price was, at one time, pushed up to £379 10s. per ton for cash, but there was some reaction in the afternoon when the advance was cut by 50s. to £7. Yesterday (Wednesday) the settlement price rose to £382. Demand is fierce for nearby supplies, although there is little inclination to project purchases to cover requirements in 1956.

The Chamber of Mines has announced that about 6,000 African Copperbelt workers will receive a wage increase of up to 29s. 6d. per 30 shifts under the job reclassification scheme.

Demand for tin is strong on both sides of the Atlantic. Fears of further unrest among the Nigerian tin miners and the announcement of another fall in stock of refined tin in London Metal Exchange warehouses by 22 tons to 276 tons were the main reasons for rising prices, which have reached a level not seen for more than 18 months.

Uncertainty about the Nigerian situation stems from a report that the wage negotiations, which have been taking place at Jos, have broken down. In New York the price has advanced to 97 cents a pound, where it is holding firm.

Demand for lead is strong here and in the United States, where smelters' stocks are still dwindling. At 23,292 short tons at the end of October, they were the lowest for several years.

The zinc market, though featureless, rules steady. Figures from the British Bureau of Non-Ferrous Metal Statistics reveal an increase in UK consumption in September to 30,080 tons from 23,261 tons in August. In the US, slab zinc production in October established a record for this year; the 89,450 short tons produced comprised 33,915 tons of special high-grade, 43,678 tons of "Prime Western", 7,768 tons of high-grade, and 2,089 tons of intermediate metal.

According to Mr. Arthur Fleming, Director of the US Office of Defence Mobilization, the Government has reduced its target of aluminium for the stockpile and has decided to extend, until April 30, the delivery of 25,000 tons scheduled for delivery in the present quarter.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* November 10, £367 to £368; November 11, £367 to £368; November 14, £379 to £379 10s.; November 15, £378 10s. to £379 10s.; November 16, £381 to £382.

Three Months: November 10, £356 to £357; November 11, £358 to £358 10s.; November 14, £367 10s. to £368 10s.; November 15, £368 10s. to £369; November 16, £370 to £371.

TIN, Standard—*Cash:* November 10, £769 to £771; November 11, £771 to £772 10s.; November 14, £774 to £776; November 15, £783 to £785; November 16, £790 to £791.

Three Months: November 10, £750 to £751; November 11, £751 10s. to £752 10s.; November 14, £754 to £756; November 15, £757 10s. to £758 10s.; November 16, £765 to £766.

LEAD—*First half November:* November 10, £107 to £107 5s.; November 11, £106 17s. 6d. to £107; November 14, £107 2s. 6d. to £107 5s.; November 15, £108 to £108 5s. *Second half November:* November 16, £107 15s. to £108.

First half February: November 10, £106 7s. 6d. to £107; November 11, £106 15s. to £106 17s. 6d.; November 14, £107 2s. 6d. to £107 5s.; November 15, £108 to £108 5s. *Second half February:* November 16, £107 10s. to £107 15s.

ZINC—*First half November:* November 10, £91 17s. 6d. to £92; November 11, £91 5s. to £91 10s.; November 14, £92 to £92 5s.; November 15, £92 to £92 5s. *Second half November:* November 16, £91 15s. to £92.

First half February: November 10, £90 15s. to £91; November 11, £90 12s. 6d. to £90 15s.; November 14, £91 to £91 5s.; November 15, £91 5s. to £91 10s. *Second half February:* November 16, £91 5s. to £91 10s.

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

November 16, 1955

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £17 1s. 0d.; Birmingham, £16 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £18 12s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £19 8s. 3d.

Scotch Iron.—No. 3 foundry, £19 5s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £21 3s. 0d.; South Zone, £21 5s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £22 0s. 0d.; South Zone, £22 3s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent. :—N.-E. of England (local iron), £19 5s.; Scotland (Scotch iron), £19 11s. 6d.; Sheffield, £20 12s. 0d.; Birmingham, £20 19s. 6d.; Wales (Welsh iron), £19 11s. 6d.

Basic Pig-iron.—£16 16s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £43 15s. 0d., scale 15s. per unit; 75 per cent. Si, £65 0s. 0d., scale 16s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £230 0s. 0d.; 38/40 per cent., £279 0s. 0d.

Ferro-tungsten.—80/85 per cent., 16s. 10d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 19s. 10d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £85 0s. 0d. to £90 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. to 30s. 0d. per unit; over 6 per cent. C, £82 0s. 0d. to £86 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C* 1s. 11½d. per lb. Cr.; 1 per cent. C,* 2s. 0½d. per lb. Cr; 0.15 per cent. C,* 2s. 2½d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £249 0s. 0d.; 96/98 per cent., £269 0s. 0d.

Ferro-columbium.—60/75 per cent., Nb + Ta, 28s. per lb., Nb. + Ta.

Ferro-manganese (home).—78 per cent., £54 10s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £26 19s. 0d.; tested, 0.08 to 0.25 per cent. C, £27 19s. 0d.; hard (0.41 to 0.60 per cent. C), £29 5s. 6d.; silico-manganese, £36 7s. 6d.; free-cutting, £31 0s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £34 12s. 0d.; silico-manganese, £36 7s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £31 11s. 0d.; basic, hard, over 0.41 up to 0.60 per cent., C, £32 13s. 6d.; acid, up to 0.25 per cent. C, £35 12s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £33 1s. 6d.; boiler plates (N.-E. Coast), £35 11s. 6d.; floor plates (N.-E. Coast), £34 10s. 6d.; sectional material, N.-E. Coast, £30 19s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £33 19s. 6d.; flats, 5 in. wide and under, £33 19s. 6d.; hoop and strip, £35 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £36 5s. 0d.; black sheets (hand mill), 17/20 g., £46 13s. 6d.; galvanized corrugated sheets, 24 g., £58 11s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £58 0s. 3d.; nickel-chrome, £81 10s. 0d.; nickel-chrome-molybdenum, £92 7s. 6d.

NON-FERROUS METALS

Copper.—Cash, £381 0s. 0d. to £382 0s. 0d.; three months, £370 0s. 0d. to £371 0s. 0d.; settlement, £382 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 3s. 7½d. per lb.; rods, 423s. 3d. per cwt. basis; 20 s.w.g., 456s. 6d. per cwt.

Tin.—Cash, £790 0s. 0d. to £791 0s. 0d.; three months, £765 0s. 0d. to £766 0s. 0d.; settlement, £791 0s. 0d.

Lead (Refined Pig).—Second half November, £107 15s. 0d. to £108 0s. 0d.; second half February, £107 10s. 0d. to £107 15s. 0d.

Zinc.—Second half November, £91 15s. 0d. to £92 0s 0d.; second half February, £91 5s. 0d. to £91 10s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £123 10s. 0d.; rolled zinc (boiler plates), all English destinations, £121 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £103 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 10⅛d. per lb.; rods, drawn, 3s. 7⅞d.; sheets to 10 w.g., 361s. 9d. per cwt.; wire, 3s. 5⅝d.; rolled metal, 347s. 6d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £223; B6 (85/15), —; BS249, —

Brass (High Tensile).—BS1400, HTB1 (30 tons), £278; HTB2 (38 tons), £285; HTB3; (48 tons), —.

Gunmetal.—RCH, 3/4 per cent. tin, —; BS1400, LG2 (85/5/5/5), £318; LG3 (86/7/5/2), £330; G1 (88/10/2/⅛), £389; (88/10/2/1), £376.

Phosphor Bronze.—BS1400, PB1 (AID released), £404 per ton.

Phosphor Bronze Strip, etc.—Strip, 509s. 0d. per cwt.; sheets to 10 w.g., 532s. 6d. per cwt.; wire, 5s. 2d. per lb.; rods, 4s. 6½d.; tubes, 4s. 4½d.; chill cast bars: solids 4s. 7d., cored 4s. 8d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 4¼d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 9d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 8d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 4d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £90 10s. 0d. to £91 5s. 0d. Nickel, £519 0s. 0d. Aluminium, ingots, £171 0s. 0d.; aluminium bronze, (BS1400), AB1, £356; AB2, £371. Solder, brazing, BS1945, 3s. 1d. lb.; granulated, 3s. 4½d. lb.

* Average 68-70 per cent.